BULLETIN OF
THE NEW YORK
ACADEMY OF MEDICINE

Vol. 13 JUNE, 1937 No. 6

The Hermann Michael Biggs Memorial Lecture

THE BEARING OF THE RESULTS OF RECENT STUDIES IN NUTRITION ON HEALTH AND ON LENGTH OF LIFE*

H. C. Sherman
Department of Chemistry, Columbia University

In the days of Darwin, science awoke to the importance of heredity; and the great wave of interest therein aroused has been in full flood for two generations. Through the work of Pasteur and his contemporaries, the great importance to human life of the bacteriology and sanitation of the body's surroundings was made clear; and for a generation students and administrators of public health problems have naturally and properly concentrated their attention upon the triumphant use of bacteriology and sanitation in the control of infectious diseases and the reduction of the death rates of early ages.

Recognition of the health importance of nutrition had to wait until after these two grand divisions of natural knowledge had become assimilated. Now, beginning in our own generation, the chemistry of nutrition is adding its contribution: correctively, in the prevention of deficiency diseases; and also constructively in the improvement of already-normal health and the extension of the life-expectation of grown people as well as of children. Chemical research into the processes of nutrition and into the nutritive values of foods is developing a new view of

* Delivered before The New York Academy of Medicine, April 1, 1937, under the auspices of the Committee on Public Health Relations.

the extent to which the life processes, and more especially the life process as a whole, can be improved through a more scientific choice and use of food.

With the discovery of vitamins and of the importance of mineral elements in nutrition and food values, science is just now arriving at a serviceably complete qualitative knowledge as to what chemical factors the food must furnish to protect the body from nutritional deficiencies. Hence the term "protective foods" which McCollum introduced some years ago and which subsequent research has justified in an even broader sense than first conceived. For the liberal use of these foods has been found not only to forestall what are otherwise the most frequent deficiency conditions but also to diminish somewhat the incidence or severity or duration of some diseases other than those which are primarily nutritional. This latter fact was effectively presented by Dr. Wilder in his Chairman's Address to the Section on Therapeutics of the American Medical Association at its Philadelphia meeting. As he emphasized, the nutritional background and foundation afforded by the habitual use of a dietary which is thoroughly well-balanced, with reference to the newly discovered as well as the longer-known factors, may greatly advance the probability of a satisfactory outcome of whatever medical measure is to be undertaken. He also suggested that in disease the rate of destruction of a vitamin in the body may be increased or for some other reason the amount needed for best results may be larger than the normal nutritional requirement. Even though this idea may have been held too enthusiastically in some quarters, there is good scientific evidence of its validity as judiciously set forth by Dr. Wilder; and, as the Journal of the American Medical Association has remarked, the profession is not to be deterred from the right use of new knowledge even when it is at the same time engaged in the correction of exaggerated hopes or claims.

The concept of a possibly rather wide zone between the merely adequate and the optimal in some aspects of nutri-

tion, which appealed to Wilder on clinical and therapeutic grounds, simultaneously received strong support from laboratory investigation. On the basis of his feeding experiments, McCollum early began to point out that there may be a difference between the passably adequate and the optimal in nutrition; and Hopkins in 1931 emphasized the view that such differences may have far-reaching effects which have previously been attributed to racial factors. For, he explains, a community may be found in equilibrium with an environment which includes its food supply, and the fact of such equilibrium has hitherto been taken as evidence that the environment supplies everything needed. Hence any inferiority was taken to be racial, whereas in fact a racial potentiality of higher development may become manifest with an improvement in the food supply.

Present-day science in general, and perhaps particularly laboratory experimentation, is constantly striving to make itself more and more quantitatively exact; and so one aspect of nutrition research is pressing on from the qualitative recognition of the chemical factors needed in nutrition to the quantitative questions: How much of these do different foods contain? How much does normal nutrition require? and finally to the more ambitious and far-reaching question, How much yields the best result as judged by well-being throughout the life-cycle and through successive generations?

When the study of human nutrition brings us to problems so comprehensive as this, we obviously need a deputy-subject in the form of an experimental animal whose natural life cycle is short enough to permit of full-life-cycle experiments; and whose food habits and nutritional processes are much like our own. These qualifications are fulfilled by the long-domesticated laboratory rat; and for our nutrition research at Columbia we have built a laboratory-bred experimental colony in which the hereditary and nutritional background of each individual is known for so many generations as to correspond with a human colony whose food supply had been known, whose

blood had been unmixed and whose family trees could be traced in all their branches, since times somewhere between Caesar and Charlemagne. With experimental animals of small size and short life, it becomes possible to study the influence of food upon health and upon length of life under conditions of fully adequate scientific control, and with large enough numbers to smooth-out the pitfalls of individual variation and to permit of convincing statistical analysis of the findings.

These experiments originated in a study of the food supply problems of the war and post-war periods and the limited purchasing power of the majority of people. Wheat was taken as typical of the low-cost foods furnishing the greater part of the nutritional calories, and milk as the typical protective food to "balance" the dietary. It was found that five parts by weight of ground whole wheat could be adequately balanced by one part by weight of dried whole milk. But an increase in the proportion of protective food, in this case milk, made the diet better, and thus enhanced the norms of health at all ages, and increased the length of life. Here, as in most scientific research, the laboratory conditions were purposely kept simple in the interest of perfection of control and certainty of interpretation. The simplification which permitted completeness of control and large numbers of experiments was helpful to the definite establishment of the principle, but does not imply any recommendation of equally simplified human dietaries. In terms of our usual food supplies the indicated improvement would mean more of fruits, of vegetables, especially the green and yellow ones, and of milk including such of its products as cheese, cream, and ice cream; probably with no decrease of egg consumption. In the experiments referred to, the single change in proportions of the staple foods composing the dietary involved its enrichment, to a substantial degree in calcium and vitamins A and G, and to a relatively small degree in protein.

In such experiments it has been found that a dietary or food supply which is already adequate to support normal

growth and reproduction and maintain normal health and length of life, generation after generation, may still be capable of such improvement as very significantly to enhance the average of nutritional well-being, with resulting higher health at all stages of the life cycle. Growth and development were expedited, a higher level of adult vitality was maintained, and the life expectation not only of the young but also of the adults was improved. The increase in the average length of adult life was such as would correspond to an increase in the human-adult life-expectation from the long-standing 70 years to 77 years instead.

This positive effect of nutritional improvement in extending an already-normal average length of adult life, though still, of course, within the range of the normal zone, was a more constructive finding than had been anticipated; and so this finding has naturally been submitted to cross-examination. The three questions most often asked in this connection are:

(1) How certain is the finding?

(2) As the experiments were with rats, how do we know that the result is true for man?

(3) Is longer life desirable anyway?

As to the first of these questions, statistical analysis shows the finding to be established with 100 times the degree of convincingness that is regularly accepted as "undoubted." This is an eminently appropriate occasion on which to plead for a wider recognition of the fact and principle thus fully established, that the hitherto accepted norms of health and of length of life can be advanced, enhanced, improved by a more scientific distribution of emphasis in the choice and use of food. Previously only heredity had been positively correlated with length of life; now food and nutrition have also been. Granted that heredity may be the largest factor in longevity, the food factor should no longer be overlooked. The statement or implication so often met, even in supposedly authoritative writings, that, while there are many ways to shorten a

normal life cycle, the only way to lengthen it is by the selection of a longer-lived ancestry, should now be definitely recognized as out-of-date. In fact it is doubly out-of-date, in that it is not true to present-day factual evidence, and that it is too fatalistic to be soundly scientific in spirit. Heredity and nutrition are both positive factors; and it is possible, by means which are within our own immediate control, both to "add life to our years," and to add years to our lives.

As to the second question, the chemistry of human and of rat nutrition is strikingly similar in most respects, and on the chief point of known difference we are more responsive to dietary improvement than are rats. Hence the possibilities of improvement revealed by experiments with rats are almost certainly within the scientific probabilities for us human beings. And this, it may be emphasized, is not an assumption, and not merely a hope; it is the only view consistent with the scientific evidence.

On the third point, much more might be said than we have time for here, but a glance at the significance of an extension of the prime of life seems certainly in order; for the newer chemistry of nutrition offers an extension of the prime of life of still greater extent than the increase in the life-cycle, development being moderately expedited and senility decidedly deferred in the same individuals by the same dietary improvement, namely, greater prominence of the protective foods in the dietary or food supply.

Commenting on the shortness of human life, the late Dr. R. S. Woodward remarked that a scientific or professional man will usually have spent a third of his years by the time he has finished his formal schooling and begun his life work, then about another third must generally be spent in developing his capacities and in proving what he can do, before he is entrusted with his highest responsibilities and opportunity; and so only one third of his years remain in which to render his best service to the world. A recent charting of age incidence of major opportunity showed that such opportunity is most frequently attained

only at about fifty as Woodward suggested; and it also showed that, in occasional cases, major opportunity may be encountered much earlier or much later.

There can be no doubt that to reach the prime of life a little earlier and to hold it a good deal longer may add very greatly to the individual's chance to achieve his ideals, and to render to others the full measure of his best service; for both these take time, even with full opportunity. The significance of this to human welfare may be still more far-reaching.

As President Merriam of the Carnegie Institution of Washington has pointed out in his essay entitled, "Are the Days of Creation Ended?", the direction of human evolution is now largely social, and society is a continuing organism interested in its own future. What promises to affect this future should influence our decisions from day to day and will do so more effectively with the growth of the scientific spirit which expects progress and works for it; but meanwhile the shortness of individual lives tends to set a limit to the actual use by man of the knowledge which he has accumulated and the institutions which he has built and developed. Hence the longer term of fully efficient years, which the newer chemistry of nutrition offers, may be of far-reaching significance to human progress in affording fuller opportunity for the use and enjoyment of the ever-growing body of knowledge.

It is doubtless with such facts in mind that Dr. McLester, in his Presidential Address to the American Medical Association, has said that science offers to those peoples who will use the newer knowledge of nutrition, not only enhanced vitality and longer life, but also higher levels of cultural development.

Our knowledge in this field is at present in a stage which calls for the clearest possible emphasis on two facts which may not always at first thought seem consistent. These are: that, on the one hand, there is enough of this new knowledge sufficiently established to justify acting upon it now; and, on the other hand, that much more research

is needed to develop its full potentialities for service to human welfare and to our better understanding of our own life processes and of the world in which we live.

Undoubtedly, the great majority of people will be benefited, the general level of the public health will be raised, and the averages of our vital statistics improved at many points by the simple taking of a larger proportion of the needed nutritional calories in the form of the protective foods.

Undoubtedly, also, the pressing forward of such further and more quantitatively exact experiments as are only just now being started, and are still seeking adequate means of material support, will greatly advance and clarify the nutritional aspects of biology, chemistry, medicine and public health and enable these sciences to use the new knowledge even more fully and with greater economy and efficiency in the service of food economics, practical dietetics, and human welfare. This fact, that recent studies mark advances of much practical value for health while also there is urgent need of further research, is true for problems ranging all the way from the feeding of an individual to the effort to make nutritional knowledge effective on a world-wide scale. In prescribing for a patient, in feeding a family, in the nutritional aspects of social work, home economics extension, and community health education, there is steady growth of the conviction that the so-called protective foods should be given a larger place in the dietary, the food budget, the community or national food supply; and immediately following upon this conviction comes the question, Just how much larger? Just what proportion of our calories should be consumed in, or what proportion of our expenditure allotted to, the protective foods? Similarly in the world movement, the Health Organization of the League of Nations finds in the published data of recent investigations ample evidence that more liberal levels of food-calcium consumption are needed by a large proportion of the people in many if not most parts of the world. The Director of this Organization, in preparing for a world-wide discussion among ex-

perts and educational effort through them to the people, asks us to suggest quantitative standards not only for minimal adequacy but also for optimal results as judged by nutritional well-being throughout the life cycle; and our laboratory methods are now developed to the point of permitting experimental elucidation of this problem. These experiments need to be carried out in larger numbers than have yet been started so that three to four years more of active experimentation are required before the added data thus actively demanded can be complete.

Thus we are, at the moment, in position to study experimentally, and we greatly need to know more about, the quantitative distribution and causes and extent of variation of the outstandingly important mineral elements and vitamin values of staple foods, and the levels of consumption of these nutrient factors which yield best results in the life history of the individual and the vitality of successive generations.

Mention has already been made of the improvement of an already adequate dietary by the increase in its proportion of staple protective food; and the fact that enrichment of the dietary in calcium, in vitamins A and G (the flavin factor) all played parts in the enhancement of nutritional well-being and resulting higher vitality and longer life thus induced. Possibly the relatively smaller enrichment in protein may also have played a supplementary part. Here there has been decided advancement of health and of length of life by improvement of an already-adequate dietary or food supply.

It thus becomes quite clear that there is a very important difference between the merely minimal adequate and the optimal in nutrition. But it does not follow that the actual optimum has yet been established. For our experiments with still higher levels of nutritional intake of calcium and of the flavin factor, while still only in their preliminary stages, give distinct promise of further enhancement of nutritional well-being at these higher levels of intake of these particular chemical factors of food value and nutritional need.

Probably no scientific student of nutrition or of health could have anticipated the extent to which this newer chemistry of nutrition can advance the normal standard of health through affording scientific guidance in the daily choice and use of our staple articles of food. Sir John Boyd Orr has recently written: "This new knowledge of nutrition, which shows that there can be an enormous improvement in the health and physique of the nation, coming at the same time with the greatly increased powers of producing food, has created an entirely new situation which demands economic statesmanship." The question as to what proportion of the British people have a food supply sufficient for the development and maintenance of the standard of health which should be the birthright of their racial inheritance has been actively debated in Parliament and anxiously studied by scientific workers; and from Downing Street there has been sent to the British colonies and dominions throughout the world a state paper entitled Nutrition Policy which proposes that throughout the Commonwealth of British Nations with their dominions, colonies, and mandates, the making of tariffs, the setting of quotas, and other such actions shall be guided by a definite policy of bringing into human consumption the kinds and amounts of foods most conducive to optimal health. The Delegate of Australia to the League of Nations has also stimulated the worldwide awareness of importance of nutrition by his slogan, "Marry Agriculture with Health." The official report of our Federal Secretary of Agriculture assures us that the goal of agricultural research and adjustment is the optimal nutrition of the people; and a recent news item reports that the schedule of allowances to farmers for cooperation in the Soil Conservation Program for 1937 is "more attractive to the . . . dairy farmers and vegetable and fruit growers than it was" in 1936, while "Federal money flowing to the cotton farmers will be somewhat reduced." If this wording as quoted from the New York Herald-Tribune makes the action of the Federal Government sound a trifle paternalistic, is it any more so than what is done every time the tariff is revised?

Sir F. Gowland Hopkins, Past-President of the Royal Society, writing in 1936, characterizes nutrition as "a national problem of unsurpassed importance." And he commends the study of M'Gonigle and Kirby's *Poverty and Public Health,* in which they say: "It must be admitted that many children of today are the victims of physical defects, and that these defects cannot but lower their efficiency and must in some cases shorten their lives. The evidence that has been adduced indicates that suboptimal nutrition plays a predominatingly important part in the production of these defects." In their opinion "Sir John Boyd Orr's estimate of ten million people in Great Britain living at or below the threshold of adequate nutrition is. . . an underestimate." They further state that "The accumulated evidence—statistical, clinical and observational—appears to warrant the conclusion that nutrition has, in the practice of clinical and State medicine, received less recognition than it deserves."

On the other hand it has been and is being emphasized by many physicians as well as in the teaching of food work in schools and colleges and in the work of extension teachers and of social relief agencies. Dr. Minot, Nobel Laureate in Medicine, tells us that man's future will depend very largely upon what he decides to eat. His word "decides" is well chosen, for conscious choice of daily food is the chief means through which scientific knowledge in this field becomes effective.

Whatever the attitude of any governmental authority on the question of fostering the production and consumption of a larger proportion of the "protective" food crops, such a shift of emphasis has already begun and will doubtless continue through the steady working of an increasingly informed and intelligent consumer demand. Statistics of food supply show that this is already happening, in fact that it has been going on gradually for some years. It is probably largely because of this gradual improvement in our use of food during the recent past that the public health has kept up as well as it has under the stress of

the economic depression; and that both boys and girls now enter college better developed at a slightly earlier age than their fathers and mothers. With the steady spread of the newer knowledge it will doubtless be used more fully as time goes on, for, as editorially remarked by the Journal of the American Medical Association, "the difference between buoyant health and merely passable health is coming to be more appreciated."

So far as can be judged from present scientific evidence, nutrition is not an alternative way of reaching a predetermined limit, but rather its benefits are added to all the benefits which one may enjoy through heredity, training, and the sanitation of the external environment. Beside these latter there is the factor of the body's internal environment, and this we are learning to understand, to control, and constructively to improve through the newer chemistry of nutrition.

Being internal and having to do rather with the efficiency of coordination of the life processes than with the great accentuation of any one of them, such chemical improvement through nutrition does not show itself dramatically as a mutation may, and as do some of the exploits of endocrinology; but it may be no less far-reaching because it is working in harmony with natural evolution. Moreover, by its very success this newer chemistry of nutrition is rapidly outgrowing the stage of easily dramatized advances such as are reducible to picturesque and specific words. The question, What particular thing does such nutritional improvement do?, hardly admits of a simpler or more specific answer than that it offers us the option of a more liberal term of years of more efficient life with which to do what we will.

One of Dr. Biggs' most quoted sayings was that public health is purchasable. To fit nutrition into the concept of public health as a purchasable commodity requires an amplification of the educational function of the physician and the health department, and a further development of nutrition teaching in the schools. The community as a

body does directly purchase out of tax funds, and for all the people equally, as complete a system of sanitation and as good a water supply as the available purchasing power permits, but food is purchased by each consumer individually. A good health officer by his own administrative action may extend the benefits of a discovery in sanitation to all the people of his community, often without their needing to know or to do much if anything about it as individuals; but in the main the people can benefit by a discovery in nutrition only as they individually learn about it and decide to be guided by it.

Simple redistribution of the present expenditures for food, and this without omitting any article of food to which any consumer is accustomed but merely by easy shifting of relative proportions, can undoubtedly contribute greatly to the advancement of the standard or norm of health and vitality in the coming years. Naturally we also hope that a larger proportion of people will soon have ampler purchasing power; and we realize that right relations between purchasing power and the general level of prices is essential to the ability of any community to get the full benefit of the new knowledge of nutrition. However, it should be realized with equal cogency that in the light of this new knowledge, food economics henceforth should concern itself less exclusively with prices and should be more guided by considerations of nutritive values of foods. For it is now clear to anyone who will study the evidence, that nutrition has greater constructive potentiality than science had foreseen, and that even in the everyday choice of food we are dealing with values which are above price, for the health and efficiency, duration and dignity, of human life.

THE CONTROL OF EXCITATION IN THE NERVOUS SYSTEM

HERBERT S. GASSER
Director, The Rockefeller Institute for Medical Research

Harvey Lecture, March 18, 1937

Ten years ago Professor Erlanger addressed the Harvey Society on the subject of the action potential of nerve. In that lecture he described the technique of recording the action potential with the cathode ray oscillograph and presented the developments which had taken place through its use in the laboratories of Washington University. One of the principal points which he made in the lecture was that a peripheral nerve is made up of fibers which conduct impulses at various velocities. If a nerve be stimulated with an induction shock, all the impulses start out together; but they soon become spatially separated, as the faster outrun the slower impulses. Thus, if a lead be taken at some distance from the stimulated point, the near electrode records first the fastest impulses and then in turn the slower impulses as they arrive. As all velocities are not equally represented, the composite action potential appears as a series of elevations, the exact configuration of which is dependent upon the fiber content of the particular nerve that is being tested.

In 1927 the potentials of all the fibers had not yet been recognized; consequently an appropriate point at which to start the presentation of this evening is the picture as it was completed two years later through the finding by Professor Erlanger and myself[10] in somatic nerves, and by Bishop and Heinbecker[4] in visceral nerves, of a system of fibers in which the velocity of conduction was much slower than the velocities previously known. These fibers were called C fibers. In mammalian nerves the largest fibers, which are the fibers of fastest conduction, carry impulses at 100 meters per second, and the slowest at less than one meter per second. An idea of the distribution of the velocities may be gained from the electrical map of the saphe-

nous nerve (Fig. 1). The fast group, made up of velocities between ninety and fifteen meters per second, appears with two major and several secondary elevations. Although the second elevation represents about as many fibers as the first, it is much smaller, since it is produced by smaller fibers and individual fibers contribute potential to the aggregate in proportion to their cross-sectional area. The third or C elevation, made up of velocities below 1.7 meters per second, represents many more fibers than the other two elevations combined,[32] but the component potentials are so small that in order to reveal the presence of the fibers it is necessary to use an amplification higher than is needed for the elevations produced by the large fibers. It must also be recorded on a much slower time scale.

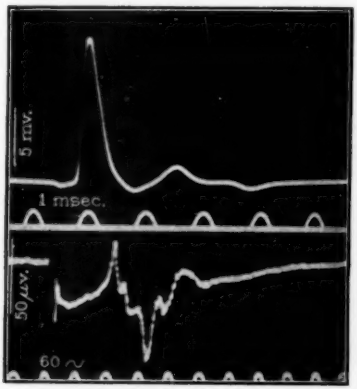

Figure 1

Nerves going to muscles differ from the saphenous nerve, which is purely sensory, in that the first elevation is relatively somewhat higher, owing to a large content of fibers of the highest velocities,[9] some of which are higher than the maximum velocities found in the saphenous nerve. These fibers are in part motor and in part sensory, the sensory fibers going to proprioceptor endings in the muscles.

What may be the significance of this wide range of velocities is a question which we have often asked ourselves.

The velocities of motor fibers are distributed about a single mode, the velocities of sensory fibers about a number of modes. This fact suggested the possibility of a relationship between the elevations in the action potential and the modalities of sensation, but the experimental evidence has turned out for the most part to be incompatible with this notion. The fastest fibers carry touch impulses but not pain, and the C fibers carry pain without touch or pressure.[5] However, pain is also found in the second elevation,[22] and overlaps warmth and probably pressure.[13] In fact it is not clear that some fibers may not mediate both pain and pressure (Goldscheider,[18] Adrian[1]). There surely must be, therefore, some reason other than the modalities of sensation for the numerous velocities. A suggestion as to what may be their function will be made later, but before discussing the matter further it will be necessary to consider some other qualities of the action potential and their relation to the physiology of the central nervous system.

The aspects of the functioning of the nervous system which we examine in the laboratory are so far removed from the manifestations of activity which we experience in everyday life that it may be worth while to say a word at the outset concerning the relation of laboratory studies to the larger problem. Admittedly the nervous system can be understood only as it is operating as a whole, but it is equally true that an insight into its working can be gained only by a detailed analysis of its parts. If the isolation of a part results in the sacrifice of some of its qualities, the loss is compensated for by the acquisition of a degree of simplicity making the part more amenable to investigation. The organization of the nervous system is such that an understanding of the mode of activity of any part of the ganglionic apparatus would mean a long step forward, for all parts of the nervous system are fundamentally alike. We can, therefore, proceed, confident in the belief that when the parts are understood, they can be added together into larger units; and that, as the addition takes place, the lost

qualities will again emerge and be recognized. Bit by bit it should be possible in the end to build back to the elaborate patterns of activity which are characteristic of the intact organism.

Like all other parts of the body, the nervous system is made up of cells. This statement contains the essence of the neurone doctrine which for half a century has dominated all thinking about the subject. The most obviously distinctive feature of neurones, as compared with cells in general, is the profuseness of their branching. Neurones are fashioned in a way so as to make possible numerous discrete contacts of one with the other. The anatomy of the nervous system puts before us myriads of possible pathways over which messages may pass from any part of the body to any other. The physiology of the nervous system reminds us that the utilization of these pathways is restricted. Excitation initiated in any part of the peripheral field does not spread in all directions in the centers, but proceeds along lines which are prepared for it, although not fixed in nature. A given afferent stream of impulses over a peripheral nerve may follow one pathway in the centers at one time and another pathway at another time. The direction of the switching is conditioned by the situation obtaining at the moment, and is always consonant with a coordinated reaction of the whole organism. Every junction point of the transmission lines at the synapses between cells is guarded. Anatomical peculiarities of the form and arrangement of endings differentiate the ease of transmission spatially, and the nature of the previous activity differentiates it temporally. Ultimately excitation in a pool of neurones is dependent upon everything which is taking place in the nervous system anywhere, because of the direct or indirect representation of this activity in the population of endings in the pool. It is for this reason that a part of the system in isolation has lost some of the plasticity of behavior which it possesses in its normal relations.

The laws describing the mode of transmission of excitation across a synapse thus must be the basic laws of the

nervous system. What happens at the synapse must be determined by the qualities of the tissues which meet at that point, by the qualities of the terminals of the axon on the one hand, and by the qualities of the cell bodies and dendrites on the other. Of these two, only our knowledge of axons is at all extensive,—this because of studies made on peripheral nerve.

Two decades ago Keith Lucas[29] proposed the hypothesis that the phenomena taking place in the central nervous system could be explained without the assumption of any properties which could not be experimentally identified in peripheral nerve. On account of the untimely death of its author, this bold hypothesis was left to his successors without adequate support. Lucas' adherents defended it for a time, but in recent years the opinion of many observers has turned away from it.

The reason for the failure of the hypothesis is not far to seek. It does not lie in Lucas' employment of the now discredited notion of conduction with a decrement, but rather in the fact that the knowledge of peripheral nerve was so meagre that it supplied but little material with which to work. The known facts had to be used in the interpretation of the hypothesis in so fanciful a manner that the result could not be accepted. When one pauses to think that the reactions of the central nervous system are very labile and continue for considerable periods of time, it is easy to realize how difficult it would be to explain them in terms of events obeying the law of all-or-nothing and lasting less than one-thousandth of a second.

If the reactions in the central nervous system are to be explained on the basis of occurrences in peripheral nerves —if nervous tissue as it appears in peripheral nerve is to be made representative of nervous tissue in general—it is evident that the starting point of all discussions must be a thorough-going understanding of the physiology of nerve fibers.

As many as have been the studies made of peripheral nerve, much still remains to be done. Previously unsus-

pected qualities are continually being brought to light, but already enough information about nerve has accumulated to permit the beginning of a composite picture of nervous tissue.

Ten years ago the term "action potential" referred to only one process, that which is represented by what is now called the spike potential. At the present time we must recognize that activity is not characterized by the spike alone, but that it means the setting in train of a series of processes each of which reveals itself by a potential change. The latter are called after-potentials, and they, as well as the spikes, vary in the composite picture.

Velocity of conduction has already been mentioned as a variable. Where fibers are otherwise homogeneous, as in the first elevation of the action potential, the difference is based simply on the size of the fibers, the velocity varying linearly with the diameter of the fiber.[14] But between the first and the last elevation some other variable enters, probably the duration of the spike, as spikes last 0.4 msec. in the fastest fibers and about 2.5 msec. or even longer in the slowest.

Spikes may be characterized as the message carriers of the nervous system, both in the tracts of the brain and in peripheral nerves. As shown so clearly by Adrian and Bronk, the messages are carried by a succession of signals or spikes in the individual fibers. The signals are all alike, but differently spaced, and the interpretation of the message at the receiving end depends upon the pattern of fibers occupied and the frequency of the signals in the individual fibers. We shall see that the frequency of arrival of impulses has an important bearing on whether or not they can pass a synapse.

Following the sequence of spikes which carries the message—and even during its continuation under appropriate conditions—, the after-potentials may be seen. They occur in their simplest form in a single response, appearing to rise out of the tail of the spike rather than being continuous with it. The potential generally is made up of

two parts, an initial, negative portion and a later, positive portion. In the fibers of fast conduction, under normal conditions, the negative portion is first seen at its maximal value. In its subsequent course (Fig. 2) it subsides along a decremental curve for a period of about fifteen msec., and then gives way to the positive portion lasting about eighty msec.[17] A representative value for the degree of positivity at its maximum would be twenty-five μv, which would be equivalent to about 0.2 per cent of the potential of the spike crest. In C fibers (Fig. 3) the positive after-potential is much larger in proportion to the size of the spike[3] and lasts up to one-half second or more. It is preceded by a negative after-potential, but no statement can be made as yet concerning the dimensions of the latter under physiological conditions. The negative after-potential in appropriate records is visibly made up of a period of development followed by a period of decline, a property which can be demonstrated in the fast fibers only under special conditions.

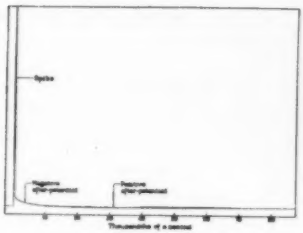

Figure 2

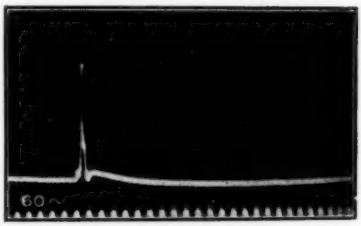

Figure 3

After-potentials stand in contrast to the spike with respect to their lability. The form of the spike is rigidly maintained through a wide variety of conditions, while the after-potentials change their form with every event that happens. Small changes in the concentration of hydrogen ions, or of the salt balance, are readily detectable and the potentials are differentially susceptible to asphyxia.[2, 15, 20, 27, 34] Tetani modify them greatly, an observation of no small importance in view of the fact that nerve messages are carried by a sequence of spikes. The principal effect

of a mild tetanus is to curtail the negative after-potential and to increase the depth of the positive potential (Fig. 4). After a more severe tetanus the positive after-potential is further increased in depth, without showing an increase in duration, until a maximum is reached; and it is succeeded by a second positive component which increases in duration in proportion to the severity of the tetanus (Fig. 5). Durations of five minutes have been observed in isolated nerves (fast fibers) and of one minute in nerves receiving their natural perfusion of blood in the body.[17] Thus it is no longer permissible to say that events of long duration are confined to the centers.

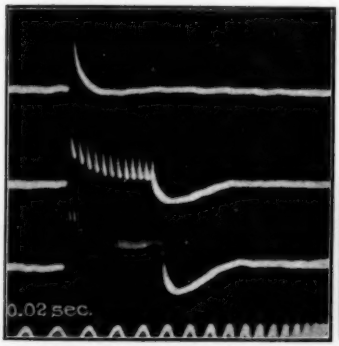

Figure 4

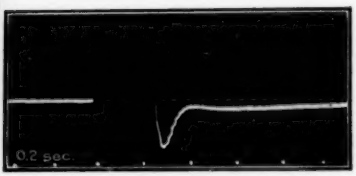

Figure 5

Undoubtedly one of the most significant facts that has come out of recent studies on nerve, from the standpoint of the application of peripheral nerve physiology to the centers, is the form of the recovery curve after excitation. It has been found that the refractory period of classical nerve physiology is succeeded by a period of deviation from normal excitability lasting as long as the after-potentials. The recovery of the fibers of fastest conduction, as measured in the body after a single response (Fig. 6), is characterized first by the refractory period (in which the fiber is at first wholly inexcitable, and later excitable only with stimuli of greater than normal intensity), then by a

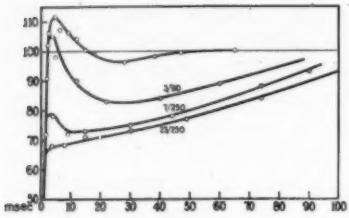

Figure 6

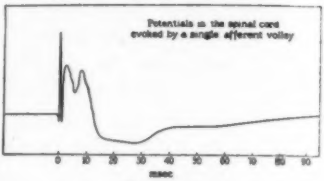

Figure 7

period of supernormal excitability lasting fifteen msec., and a period of subnormal excitability lasting eighty msec.[17] These periods in turn are related to the spike, the negative after-potential, and the positive after-potential. In other conditions the form of the excitability curve differs widely from that which has just been described, but in every instance the changes parallel the course of the after-potentials. For example, if the potential oscillates between negative and positive, as it does in tetany, the excitability oscillates with it; or if the positive potential is increased and prolonged, as after a tetanus, the subnormality likewise is increased and prolonged. If the spikes may be called the message carriers of the nervous system, the after-potentials in contrast may be called the indicators of the readiness with which messages will be accepted.

After this brief summary of the qualities of axons we are in a position to consider the extent to which these qualities represent the qualities of the parts of the neurone which enter into the formation of the synapse. Synapses are formed by contact of axon branches with the cell body or its dendrites. The axon branches may be expected to partake of the properties of the parent stem; but a question may be raised with respect to the cell bodies and dendrites, inasmuch as in their cytoplasm are found structures which are not present in axons. However, if the descriptions of these structures be reviewed, it is found that there are present only those structures which are generally found in cells; in other words, the structures which must be present if the normal vegetative functions of the neurone are to

go forward. Thus the histological picture does not provide a compelling reason for concluding that cells and axons are different in nature.

Grey matter and white matter are differentiated by their metabolic needs. Greater vascularity, greater oxygen consumption, and greater susceptibility to asphyxia are characteristic of the centers as opposed to the fibers. But here again the difference is not traceable to cells. Gomez and Pike[19] found that the dorsal root ganglia are not sensitive to anemia; Holmes [24] found that the metabolism is not high, and Dunning and Wolff[6] found that the vascularity is not great compared with peripheral nerve. Dorsal root ganglia are without synapses. In line with the suggestions of these authors, the high metabolism and high vascularity of the grey matter of the nervous system must be connected with the structure of the synaptic system. The strands of protoplasm which enter into the synapses are numerous and fine. According to current notions about the intimate structure of irritable tissues, conduction takes place along a delicately poised surface film which is maintained in repair only at the cost of a continuous expenditure of energy derived from oxidation. Removal of oxygen soon brings about loss of conduction even in peripheral nerve. It is to be expected, therefore,—in view of the fact that the area of the surface of a given volume of cytoplasm increases inversely to the diameter of the strands of which it is made up—that the metabolism in the fine strands of the neuropil would be higher than in the cell bodies or axons. In order to keep up the surface, a small strand must oxidize faster than a large one. Thereby it is made more dependent upon available oxygen and thus is caused to be the first to disintegrate when oxygen is removed. Support for this argument may be derived from the fact that the small nerve fibers, which are responsible for the second elevation of the action potential, are blocked by asphyxia before those in the first elevation.

In the end the question of whether cells and dendrites are different from axons must be settled by direct observa-

tion. One method of examining them is to measure properties of the former and to compare the result with measurements of the same properties in the latter. There are available two sets of measurements which are particularly useful for this purpose; both have been made by Lorente de Nó[28] on the oculomotor nucleus.

The first measurement is of the period of latent addition. When a subthreshold impulse current of short duration is applied to a nerve fiber, for a brief period thereafter an effect is produced which permits a second impulse current, by itself ineffective, to bring excitation to threshold. The time during which this summation of effects takes place is known as the period of latent addition. In motor fibers it lasts about 0.2 msec. To test this phenomenon at the synapse requires the bombardment of the nucleus with two volleys of impulses in two portions of the tract fibers. When the two volleys arrive simultaneously, summation is at its best. If they are separated by more than 0.2 msec., summation falls off rapidly, and it disappears almost entirely at separations of 0.4 msec. Considering the difference in the testing mechanism of axon and neurone, the correspondence in the periods of latent addition of the two is very close indeed, much closer in fact than the periods of latent addition in different kinds of axons.

The second measurement is of the absolutely refractory period, that is, of the interval during which a second response cannot be evoked by a stimulus of any kind, no matter how intense. In motor fibers the period lasts from 0.4 to 0.5 msec. Measurements previously made of the absolutely refractory period of neurones have been unsatisfactory, because a supermaximal stimulus is required for the testing, and excitation of neurones by way of their synapses is limited by the possible density of active terminals. In the oculomotor-nucleus preparation, however, the necessary density of endings was found and the refractory period turned out to be 0.6 msec.—a value so close to that holding for axons as to leave no doubt that the two are identical.

Another aid to the comparison of neurones and axons is found in the potentials of internuncial neurones and

their behavior under various experimental conditions. Surprising as it may appear at first sight, electrical studies of the grey matter of the spinal cord are capable of yielding valuable information about its activity, despite the unfavorable situation presented by the intertwining in all directions of the numerous fine strands of the neuropil. The same characteristic, basic potential picture is obtained with great regularity;[16, 25] and the variations found are only those which are to be anticipated from the extent of the connections with other parts of the brain stem permitted by the conditions of the experiment, and from the state of the preparation. The differences may be accounted for largely on the basis of the extent of spread which is possible into the delay paths of Forbes[11] or the reverberatory arcs considered by Kubie[26] and by Ranson and Hinsey.[33]

When a single afferent volley enters the spinal cord (Fig. 7), if gross leads from the surface of the cord are employed the first visible event is the spike potential in the continuation of the fibers in the dorsal columns. Following this potential and separated from it by the time consumed at the synapses, the potential in the internuncial neurones appears. The potential in the motor neurones is also detectable, but it makes a very small contribution to the potential recorded with the leads which are being described.

In its basic form the internuncial potential consists of two parts, an initial negative portion lasting about ten to twenty msec., and a later positive portion lasting 100 msec.; but in its variations the potential differs widely from this form, there being a succession of other events lasting a second or longer. When the picture was first seen[16] it was difficult to interpret, as the necessary facts about mammalian nervous tissue were not known, and it became evident that the interpretation could not go forward until the missing information was supplied. Accordingly, the cord studies were suspended and a flank attack was substituted for a frontal advance. After the compo-

site picture of the time course of the potentials in mammalian fibers began to take form it became increasingly clear that the internuncial potentials follow a similar course.

The best interpretation that has been found is that the initial negative portion is made up of spikes temporally dispersed, and the ensuing positive portion of positive after-potential. The disproportion between the magnitudes of the two parts as compared with those in nerve fibers of rapid conduction can be accounted for by the much greater reducing effect of temporal dispersion upon the very short spikes than on the long after-potentials. It is also possible that the positive potential is large in the individual internuncial neurones, as it is in fibers of slow conduction.

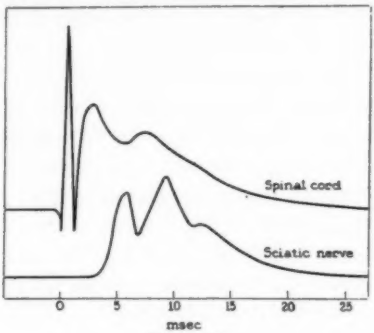

Figure 8

Additional evidence that the initial negative period is made up of spikes is found in its relation to the discharge of impulses by the motor neurones. The period of the discharge and the duration of the negative potential parallel each other (Fig. 8). As the local excitatory effect in the motor neurones does not last longer than 0.5 msec.,[28] the only way in which the succession of motor impulses could be kept up would be through excitation of the neurones in succession. This would mean that the motor neurone pool is being bombarded by spikes from the internuncial neurones throughout the time during which the potential of the latter is negative.

In the summary of the properties of axons it was mentioned that the excitability of the axon correlates with its potential. Correlation of potential and excitability must, therefore, be demonstrated in internuncial neurones if the hypothesis of similarity of the axon and the synaptic portions of the neurone is to hold. When the neurones are subjected to the test they pass it perfectly. They do not reach a state of responsiveness to a second afferent volley, equivalent to that obtaining in the equilibrated steady state, until all trace of positive potential residual from the first response has disappeared. The refractory period is followed by a subnormal interval (Figs. 9, 10) without intervention of measurable supernormality, as would be expected from the absence of demonstrable negative after-potential, and in keeping with the recovery curves of peripheral nerve conditioned by a short train of spikes (lowest curve, figure 6) instead of by a single one. (Occasionally supernormality is absent in peripheral nerve after a single conditioning action.)

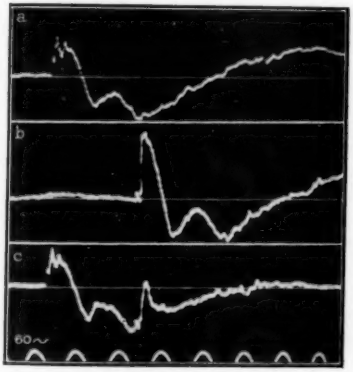

Figure 9

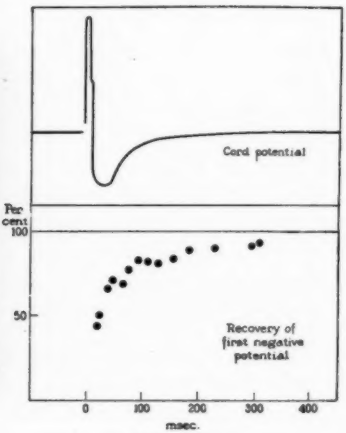

Figure 10

The correlation which occurs between the excitability of internuncial neurones and their potential throws new light on an old problem. We have seen that discharge of

the motor neurones is brought about by their bombardment with internuncial volleys during the period in which the internuncial potential is negative. From this observation it should follow that during the subnormal excitability of the internuncial neurones obtaining in the course of the positive potential, the failure of a calibrated afferent volley to evoke the full quota of negative potential (excited internuncial neurones) should result also in failure to bring about a normal reflex response. This is exactly what happens.

The relationships are brought out most vividly in experiments on the flexor reflex, in which a conditioning volley too weak to produce a motor response is followed by a testing volley sufficiently strong in isolation to produce a good contraction of the muscles.[8, 25] If the second volley falls during the period of negative internuncial potential of the first volley, it may be reinforced by the latter with a resultant facilitation of the reflex. On the other hand, if the separation is such that the second volley can no longer be facilitated, the size of the reflex will depend almost entirely on the amount of internuncial potential evoked by the second volley. Presumably because subnormality of the neurones excited by the first volley would prevent contribution of part of the excitation that would be necessary to bring into activity the larger pool of neurones which the larger testing volley would normally excite, the internuncial activity produced by the second volley may be very small and the reflex greatly reduced. In the language of the physiology of the central nervous system, the reflex would be inhibited.

Inhibition is a term of convenience used without exact definition in connection with a group of phenomena having certain qualities in common. The essential condition is the stoppage or prevention of action through the temporary operation of a process which does not harm the tissue. It is usually also implied that the process results from nervous activity, or imitates the results of nervous activity.

In the absence of an exact definition, current usage is the only guide to the employment of the term. Stoppage of the heart through the vagus is one of the most commonly cited instances of inhibition. But it is equally correct to say that the flexor reflex is inhibited by previous activity. Clearly, the term "inhibition" must apply to very different mechanisms. Inhibition of the heart is attributable to the intervention of a humoral substance, acetylcholine. The cardiac tissue is altered. Inhibition of the flexor reflex is caused by the high threshold of the internuncial neurones. The so-called "inhibited" motor neurone is unaltered; it simply has failed to be excited. It is improper, therefore, to speak in terms implying that there is a general explanation of inhibition. One can only describe mechanisms which would be included in that category.

The large number and the diversity of the theories about the nature of inhibition in the nervous system may be taken as a measure of the obscurity which has surrounded the subject. Some of the theories are hardly more than restatements in other terms of the fact that the neurones are inhibited. Others are fabricated in analogy with conditions making for unresponsiveness in other situations. A humoral agent is often postulated, but no such agent has been found; nor is there any evidence for two kinds of fibers, excitatory and inhibitory, nor for two types of endings of one type of fiber. The Wedensky mechanism and anodal polarization are also not infrequently mentioned. In every instance the suggestions can neither be accepted nor rejected.

The subnormal period of responsiveness but recently discovered in nerve by H. T. Graham,[21] thus stands in contrast with the other possible explanations of inhibition which have been suggested, in that it has been found to be experimentally applicable to the cases of inhibition in which it has been tried. Descriptions of the phenomena connected with inhibition elsewhere also indicate that there are many other situations in which it will fit. We have seen how the flexor reflex is inhibited when the internuncial neurones fail to respond as the result of an induced high

threshold. We shall now see that failure to respond can also occur because of a raised threshold of the motor neurone itself. Following a tendon jerk, such as the knee-jerk, the background excitation of the muscle stops for a time equivalent to the subnormal period of a motor fiber. This interval is known as the silent period.[23] The same phenomenon can be produced by exciting the motor neurone antidromically through its axon.[7] The latter experiment shows that antidromic excitation passes back over the neurone as far as the synapses; that the synaptic region of the neurone has the same period of subnormality as the fiber; and that while the raised threshold is in progress, the neurone cannot be excited by the impinging volleys from the internuncial neurones. It shows furthermore that the subnormality of the motor neurone, after its occupation by the reflex, is all that is necessary to explain the silent period. Very probably, however, the reflex is also followed by a decreased bombardment of the motor neurones during this period, because of the subnormality which would be produced at the same time in the internuncial neurones, owing to the spread of excitation over them from the stretch afferent fibers.

The general properties of inhibition are well known from the classic experiments of the Oxford school, carried out under the leadership of Sir Charles Sherrington. Inhibition appears at various intensities; it accumulates by summation of the effects of a succession of afferent volleys; it lasts 0.1 sec. or longer, and its subsidence follows a typical curve of decay. In these respects its behavior follows exactly that of the subnormal period of peripheral nerve, for in the latter the intensity and duration also depend upon the number of impulses which produces it, beginning with about 0.1 sec. for a single response. Accumulation of subnormality in nerve is attended by augmentation and prolongation of the positive after-potential. In this connection some fragmentary observations on the internuncial neurones of the cord are of interest; in these a tetanus was succeeded by a prolonged positive potential and diminished responsiveness.

Inhibition is usually described as being pitted against excitation, the description being based on the fact that an inhibited activity may be reinstated by intensifying the exciting afferent volleys. This again is what would be expected from the properties of the subnormal period. Subnormality is a matter of thresholds only; if excitation is brought to the limen, a full-sized response is obtained. Thus a neurone with raised threshold would be induced to respond if more active endings were brought to play upon it, or if successive volleys could be made to arrive during the period of latent addition. Then, with the neurone restored to the performance of its proper function in the chain, the reaction in which it takes part would be reinstated.

No mechanism for bringing about inhibition can have very wide application, however, unless it will account for reciprocal innervation: the fact that when one muscle contracts, its antagonist relaxes. This case is the most difficult of all to explain. Its consideration demands taking into account both the nature of the neurone linkages and the effect of the timing of impulses.

The *timing* of impulses is an aspect of nervous activity which has received little attention, although it is in all probability of great importance. It may indeed be the occasion for the numerous velocities of conduction in nerve trunks which were mentioned previously and for which no satisfactory explanation has as yet been found. Their purpose may be to insure the arrival of impulses at the secondary neurones in the proper time relations. Let us consider some peripheral event, like an injury to the foot. The first report would come to the spinal cord in about thirteen msec.; two msec. later impulses would be on their way out over the motor nerves, and only ten msec. later (on the basis of data obtained in animal experiments) would the first impulses arrive at the brain at the level of the medulla. In the meantime, impulses would be approaching the cord over some of the more slowly conducting lines. The first of the impulses capable of arousing a sen-

sation of pain would require forty msec. to reach the cord, and the sensation itself would be felt only after half a second (Piéron).[31] Even at that time, however, the first impulses over the slowest fibers would not yet have reached the cord. The fastest impulses in the slow pain system would require three-quarters of a second, and the slowest about a second and a half.

These figures give some idea of how impulses starting simultaneously from a common point become separated. Electrical records from the cord show that the first impulses to arrive produce a large amount of activity,[30] and this activity has a marked effect on the subsequent course of the excitability of the cord neurones. It is quite possible that the function of the impulses which run on ahead of the others is to adjust the excitability of the synapses in preparation for the arrival of the later impulses. By carrying the idea of timing one step further it is possible to account for reciprocal innervation in terms of the known properties of nervous tissue.

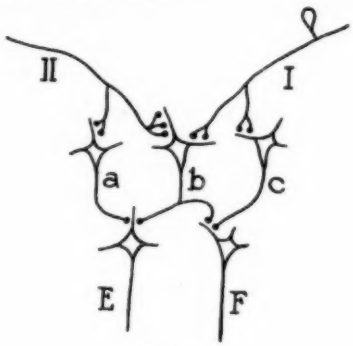

Figure 11

In the accompanying schema (Fig. 11) the linkages are hypothetical, but drawn in accord with the known facts. Excitation at the synapses is widely held to be proportional to the number of active endings, and this view is followed in the interpretation of the schema. For the sake of the

argument, the minimal number of endings which must be active for excitation to occur is arbitrarily taken to be two. Use is then made of the fact that the period of latent addition is not over 0.5 msec., and that subnormality increases with the number of responses.

If a neurone *b* common to two pathways be switched out of one pathway when it is taken up by another, the necessary condition for reciprocal innervation would be fulfilled. Let us suppose that rhythmic stimulation of fiber *I* is maintaining a flexor reflex. Neurones *b* and *c* are excited, and their discharges arriving synchronously at *F* cause it to respond. Then let us suppose that in the course of this response an extensor reflex is set up through stimulation of fiber *II*. The latter can excite *b* in the intervals between the responses to *I*, because of the stronger excitation which it is able to deliver through its three endings. No discharges can result therefrom in *F*, as the impulses in *b* are out of time with those in *c*; and *I* is no longer able to excite *b* and *c* in unison, because of the raised threshold of the former. Neurone *b* is dominated by fiber *II*. Its discharges are caused to be synchronous with those in *a* instead of with those in *c*, and activity begins in *E*. Thus, when innervation of the extensor muscles starts it must be withdrawn from the flexor muscles.

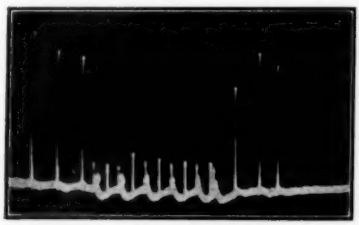

Figure 12

The taking over of a neurone by intercurrent stimulation may be imitated on peripheral nerve. Figure 12 shows the responses of the phrenic nerve to weak shocks at twenty per second. Intercurrent stimulation of the nerve with

stronger shocks at the same frequency causes most of the fibers which had been responding to the original series to fail to do so.

Notwithstanding the fact that inhibition may include other processes as well as that described, and that the explanation of reciprocal innervation must be taken only as illustrative of how subnormality may be applied to the problem, the value of utilizing the properties of axons in the interpretation of the physiology of the centers is, I think, apparent. The applications of other properties await development. In order to indicate that there are

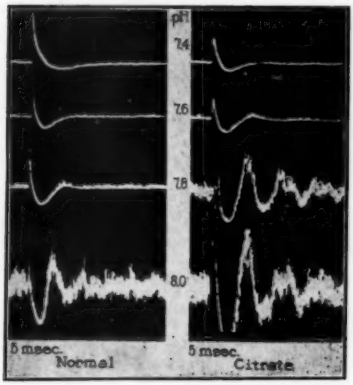

Figure 13

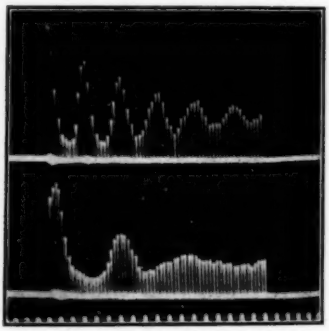

Figure 14

other possibilities, I shall mention in conclusion the representation in peripheral nerve of a property which is often considered as though it were exclusively central—namely rhythmicity.

There are at least two rhythms in nerve, but the most obvious rhythm is the oscillation in the after-potentials. Following a single response of a mammalian fiber at the normal reaction of the body, oscillation of the after-potential is not readily made out, and it becomes rapidly attenuated; but if the nerve be made alkaline, or if it be deprived of calcium (Fig. 13), or asphyxiated, the oscilla-

tion becomes obvious, its period shortens, and it passes through a number of cycles before it is lost to view.[27]

Nerves so treated are in tetany and subject to spontaneous firing of their constituent fibers, but the intensity of the firing varies with the changes in excitability. During the subnormal periods at the troughs of the waves the firing is decreased, or one may say inhibited. And during the supernormal periods at the crests of the waves the firing is augmented or facilitated. It was records like these which prompted my suggestion two years ago that there is an analogy between the first sub-normal period and the silent period of motor neurones following a knee-jerk, and a possible relationship between the second supernormal period and the rebound discharge that follows the silent period.[12]

Although rhythm is not obvious in the after-potential at normal reaction, it becomes very clear when the nerve is excited with a train of shocks from a thyratron adjusted to stimulate only a group of the most irritable fibers (Fig. 14). The initial responses condition the fibers involved, and during the ensuing subnormal period the fibers drop out in relation to the narrowness of the margin between their resting thresholds and the shock strength employed. In the rebound they appear again and help to keep up the cycle, but eventually secondary events equilibrate all fibers to a common excitability. If the responses were sufficiently asynchronous, they would not be seen individually, and all that would be visible would be the envelope of the crests of the waves. The latter would then appear like the waves which are recorded from the spontaneously active nervous system. Different as are the conditions in the two cases, the nerve analogy serves to show how neurones which are subject to reexcitation in closed circuits would fall into a rhythm of response dependent upon their own natural period of excitability.

Nerve fibers have been studied for years, while the mechanics of the nervous system is almost an untried field. If I have given too little time to recounting the accumu-

lated facts about the physiology of fibers and spent too much time in looking over the fence into the new field, it is because this lecture has been motivated by the idea that for the understanding of the nervous system it is better, before turning to postulates, to look to peripheral nerve for what it has to offer of suggestions and explanations.

FIGURES

Fig. 1. Action potential of the saphenous nerve. The nerve is mounted in serum equilibrated with 5 per cent of O_2 in CO_2. 37° C. Conduction distance 41 mm. The upper record shows the elevations produced by the faster fibers. The lower record shows the C fibers. They appear on the positive after-potentials of the fast fibers, the spikes of which are bunched near the break in the line. Although the distal lead is from killed nerve, the C elevation is recorded from both leads and hence is repeated in an inverted position.

Fig. 2. Diagram of the potentials in a mammalian nerve fiber in their normal relationship in a single response.

Fig. 3. Potentials in C fibers, splenic nerve of the cat. The spike elevation, which has a secondary group in its falling phase, is succeeded by a negative after-potential (from which it is separated by a notch known as the diphasic artifact) and a long positive after-potential. Isolated nerve at 37° C.

Fig. 4. Alterations produced in the after-potentials in a phrenic nerve by short tetani. a) single response, b) tetanus at 180 per second, c) tetanus at 350 per second. 37° C. Time, 20 msec.

Fig. 5. After-potentials in a phrenic nerve after a longer tetanus. The tetanus starts at the break in the line; the spikes go far beyond the record. The potential is first visible as the negative after-potential and is continued by the positive after-potential in two parts. (Gasser and Grundfest).

Fig. 6. Excitability curves of the saphenous nerve of the cat *in situ*. Ordinates. Excitability in terms of resting thresholds (reciprocals of shock strength). Abscissae: Separation of conditioning and testing shocks. The upper curve is conditioned by a single shock; the other curves are conditioned by tetani as indicated, e.g. 3/90 means three shocks at ninety per sec. (Gasser and Grundfest).

Fig. 7. Potentials in the spinal cord evoked by a single afferent volley.

Fig. 8. Relation of the reflex discharge into the sciatic nerve to the internuncial potential in the lumbar cord of the cat. (Spinal preparation). (Drawn from Hughes and Gasser).

Fig. 9. The effect of previous activity on the responsiveness of internuncial neurones in the spinal cord of the cat. a) Response to a submaximal volley from the tibial nerve. b) Response to a volley from the saphenous nerve. c) The two volleys in succession. Note the decreased response to the volley from the saphenous nerve and the effect of the latter on the late part of the response to the tibial volley. Spinal preparation. Concentric needle electrodes in unexposed cord.

Fig. 10. Size of response of internuncial neurones in relation to the potential evoked by a conditioning volley. Conditioning and testing shocks of the same size and applied to a sensory root. (Drawn from Hughes and Gasser.)

Fig. 11. Schema illustrating reciprocal innervation.

Fig. 12. Effect of a dominating train of stimuli on the rhythm of response of a phrenic nerve. Stimuli of near-threshold strength are applied at a frequency of twenty per second through one pair of electrodes, and midway between the responses another train of the same frequency is started with stronger shocks at electrodes further removed from the leads. The larger responses to the latter are seen as faint lines followed by positive after-potentials. During the intercurrent tetanus most of the fibers accessible to the first train are taken over into the rhythm of the intercurrent train.

Fig. 13. Accentuation of the rhythm of the after-potentials in the phrenic nerve by increased alkalinity and by deionization of calcium. The first column shows the effect of altering the hydrogen ion concentration alone, the second column the behavior at the same pH values 80 minutes after exposing the nerve to the same saline with citrate added. The spikes occur at the first breaks in the lines and are not visible. When the alkalinity is high, spontaneous firing of the fibers occurs. 37° C. Conduction distance, 4.5 cm. (Lehmann).

Fig. 14. Rhythmic response of the phrenic nerve of the cat to a train of shocks of constant strength selected to include the low threshold fibers only. The upper curve differs from the lower in that the nerve is more alkaline. The two rhythms are rapidly interchangeable. Time, sixty cycles. Frequency of stimulation, 220 per sec. 37° C.

REFERENCES

1. Adrian, E. D.: The Mechanism of Nervous Action. Philadelphia, University of Pennsylvania Press, 1932.
2. Amberson, W. R., Parpart, A., and Sanders, G.: Am. J. Physiol., *97*, 154, 1931.
3. Bishop, G. H.: J. Cell. and Comp. Physiol., *5*, 151, 1934/1935.
4. Bishop, G. H., and Heinbecker, P.: Am. J. Physiol., *94*, 170, 1930.
5. Clark, D., Hughes, J., and Gasser, H. S.: Am. J. Physiol., *114*, 69, 1935.
6. Dunning, H. S., and Wolff, H. G.: Trans. Am. Neur. Assoc., *62*, 150, 1936.

7. Eccles, J. C., and Hoff, H. E.: Proc. Roy. Soc. B., *110*, 483, 1932.
8. Eccles, J. C., and Sherrington, C. S.: Proc. Roy. Soc. B., *107*, 535, 1930/1931.
9. Erlanger, J.: Am. J. Physiol., *82*, 644, 1927.
10. Erlanger, J., and Gasser, H. S.: Am. J. Physiol., *92*, 43, 1930.
11. Forbes, A.: Physiol. Rev., *2*, 361, 1922.
12. Gasser, H. S.: J. Physiol., *85*, 15 P., 1935.
13. Gasser, H. S.: A. Research Nerv. and Ment. Dis., Proc., *15*, 35, 1935.
14. Gasser, H. S., and Erlanger, J.: Am. J. Physiol., *80*, 522, 1927.
15. Gasser, H. S., and Erlanger, J.: Am. J. Physiol., *94*, 247, 1930.
16. Gasser, H. S., and Graham, H. T.: Am. J. Physiol., *103*, 303, 1933.
17. Gasser, H. S., and Grundfest, H.: Am. J. Physiol., *117*, 113, 1936.
18. Goldscheider, A.: In Bethe, A., and others, Handbuch der normalen und pathologischen Physiologie. Berlin, Julius Springer, 1926, *11*, 193.
19. Gomez, L., and Pike, F. H.: J. Exper. Med., *11*, 257, 1909.
20. Graham, H. T.: Am. J. Physiol., *104*, 216, 1933.
21. Graham, H. T.: Am. J. Physiol., *111*, 452, 1935.
22. Heinbecker, P., Bishop, G. H., and O'Leary, J.: Arch. Neur. and Psych., *29*, 771, 1933.
23. Hoffmann, P.: Zeit. f. Biol., *70*, 515, 1919/1920.
24. Holmes, E. G.: Biochem. J., *26*, 2005, 1932.
25. Hughes, J., and Gasser, H. S.: Am. J. Physiol., *108*, 295 and 307, 1934.
26. Kubie, L. S.: Brain, *53*, 166, 1930/1931.
27. Lehmann, J. E.: Am. J. Physiol., *118*, 600 and 613, 1937; *119*, 111, 1937.
28. Lorente de Nó, R.: Am. J. Physiol., *111*, 283, 1935; *113*, 505, 1935.
29. Lucas, K.: The Conduction of the Nervous Impulse. London, Longmans, Green and Company, 1917.
30. Odoriz, J. B., and Gasser, H. S.: Unpublished observation.
31. Piéron, H.: Compt. rend. Soc. biol., *103*, 883, 1930.
32. Ranson, S. W., Droegenmueller, W. H., Davenport, H. K., and Fisher, C.: A. Research Nerv. and Ment. Dis., Proc., *15*, 3, 1935.
33. Ranson, S. W., and Hinsey, J. C.: Am. J. Physiol., *94*, 471, 1930.
34. Schmitt, F. O., and Gasser, H. S.: Am. J. Physiol., *104*, 320, 1933.

RABELAIS AS A PHYSICIAN*

FREDERICK T. VANBEUREN, JR.

If he had been nothing but a physician it would be relatively simple to make yourself a mental picture of Maitre François Rabelais, Docteur en Médicine, Université de Montpellier. In his silken robe and many cornered hat, his staff and gloves at hand, he sits in his high-backed consulting room chair and looks seriously at his uneasy patient. "Dommage!", You can hear him say, "C'est dommage. Alors, est ce que vous avez le pisse chaud?" You can see the amused quirk of his lips, nearly hidden by the thick moustache, and, at first perhaps a trifle offended, you suddenly catch the look of grave sympathy in his keen, dark eyes. A feeling of comfort flows into you again with a conviction of his knowledge, his kindness and his honesty. Will you not affirm, with his other patients, "Un de ces hommes les plus charmants."

Can you not feel the knowledge of humanity as well as of books in this man who, speaking of earlier medical writers, said in his dedicatory epistle to Book IV, "Above all, the aforementioned authors have had special advice to give the Physician concerning the words, remarks, discourse and conversation which should take place between him and the patients by whom he is summoned, the object being that all should tend to one end, namely, the cheering of the patient (without any offence to God) and the avoidance of anything that may, in the least, serve to make him sad."

Can you not feel the genial kindness in him from his little prologue to the story of his fabulous Giant Gargantua

"My friends who are about to read this Book
Please rid yourselves of every predilection;
You'll find no scandal, if you do not look,
For it contains no evil or infection.
True you'll discover, upon close inspection,
It teaches little except how to laugh:
The best of arguments; the rest is chaff,
Viewing the grief that threatens your brief span;
For smiles, not tears, make the better autograph,
Because to laugh is natural to man."

* Delivered before the Sect. of Historical & Cultural Medicine, Jan. 13, 1937.

Yes! if he had been nothing but a physician, it would be easy to make a simple, pleasant picture of this kindly soul, for he believed that Nature was right and that the thing to do was to obey her and follow her. But Rabelais was so much more than a Physician. He was a living, active, energetic fragment of that complicated, fascinating period of time, the so-called Renaissance of which we hear so much and of which we really know so little.

The Renaissance was his background and his milieu and we have to look at his figure against it and within its confines. It was a marvelous period and a period of marvels. Miracles were still occurring and were still believed in. Alchemists flourished, astrologers throve and prognosticators blossomed everywhere. So little comparatively was actually known that you could believe almost anything you wanted to believe. Ignorance was so general that the imagination had freer play than in these days of knowledge and proof. Yet there was science of a sort, and above all there were literature and art. The two latter were fostered to some degree by the church but science was looked upon somewhat askance as a probable enemy of authoritarianism. The dark, destructive five centuries of barbarian domination over the civilized world were past and forgotten; but the domination of the Ecclesiastical Powers, which would seem just as barbarous to us, had replaced it in the eleventh century, and as late as the fifteenth century, lay like a heavy shadow across the path of progress.

Already this shadow was beginning to be lifted. Relieved of the necessity of fighting for mere existence, men had begun to fight for the right to think for themselves. Within the Church, which had grown into a sort of superstate claiming sovereignty over the states of Europe, Luther and Calvin had aroused a storm of criticism against the corruption and abuses of established authority. The storm they aroused scathed Luther and destroyed Calvin but from it grew the Reformation which split the Church wide open and eventually sapped its power.

Outside the clerical body of the Church itself, kings as well as common men had begun to rebel against its iron domination. Henry of England, enamored of Anne Boleyn, was getting up his courage to dispense with its withheld permission to divorce Catherine of Aragon. Rabelais was satirizing the ignorance and oppression which he appreciated the better because of his own bitter experiences.

The latter half of the fifteenth century may be likened to none other so well as that in which we live, for it produced three prime inventions or discoveries which destroyed the Past and transformed the Future. Those agencies were the printing press, gunpowder and the mariner's compass. Gunpowder had nearly completed the destruction of the Age of Chivalry; the printing press had begun to enlighten the dark Age of Ignorance; and the mariner's compass was slowly strangling the Age of Romance. That heritage of Chivalry, the almost utter feudal dependence of the small upon the great, still hung over the countries of Europe; and Rabelais, as we shall see, must have his Patron, du Bellay, just as the fortunes of du Bellay hung upon the King.

It was a time when the hardihood of men's religious beliefs was legally tested by blazing faggots and the rack. It was a time of restlessness and insecurity of mind as well as of body and of fortune; a time as desperately unsettled and with its unsettlements as ill understood as they are today. One might, as du Bellay, be a Cardinal at sixteen, a King's envoy full of honors and esteem at forty, and a crippled and discredited refugee at fifty, dying of gout in an obscure hill village on the way home from virtual banishment. One might, as Martin Luther, be a blazing firebrand of enthusiastic Reform at one moment and, at another, be destroyed by the back-fires one's own revolt had ignited. One might, as Rabelais, be hailed one year as "the honor and sure glory of the healing art", and a very few years later, be forced to flee the country before the implacable enmity of the Faculté de Théologie of the dreadful Sorbonne. It was a world whose many sides and aspects, seen through the perspective of four hundred years induce

kaleidoscopic confusion in the modern mind and obliterate one brilliant picture by another in the wearying imagination.

Through it all, the lamp of learning began to burn brighter and more strongly with the stored up fuel of ancient wisdom: wisdom brought from Byzantium, after its fall in the middle of the Fifteenth Century. Contrasted with the intellectual poverty of the darker ages gone before, here was a feast of reason; and the brain-hungry brethren of the early Renaissance fell avidly upon these precious documents and devoured them greedily.

This group of scholars, because they were devoted to these litterae humaniores, called themselves Humanists and bathed luxuriously in the springs of Greek and Latin origin. Amusingly enough, because these ancient sources were but newly rediscovered, they termed the profitable study of them the New Enlightenment. The Humanists prided themselves no little on the superiority of their new-old learning to the rigidly prescribed limitations of that scholasticism from which they had just declared their freedom.

Among these newly enlightened Humanists we find François Rabelais, a man of spiritual substance in learned circles. He reads Greek and Latin; he translates one into the other and both into his native French. He knows and is known by Erasmus and Budé, perhaps the greatest scholars of the day; and is a friend of Tiragueau and Bouchard. He admires, and later flouts Luther and Calvin. He tears off his monkish garb and studies Medicine. He writes new Translations of Hippocrates and Galen which excite the applause of his learned colleagues. He follows these with fabulous story books which bring him eventually undying fame, but, meanwhile, the unquenchable enthusiasm of the people and the implacable enmity of the orthodox Church. He secures the patronage of the du Bellays and the favor of the King. He attends hospital; is present at the meeting of rival Kings; flees from the threats of the Sorbonne; visits the Papal Court; flits about like a shadow, ceaselessly restless, insatiably curious, in-

curably cheerful in the face of difficulties and disappointments. He secures the Pope's absolution for his apostasy to church rules and for his extraordinarily informal doffing of the monkish robe for the Doctor's gown. He receives two livings from the church and, two years later, is forced to resign them. He died in 1553, no one now knows how nor where.

One can not truly see Rabelais as a physician who has not followed him through his long preparation for a liberal science and art through the narrower fields of theology and law.

Born near the end of the Fifteenth Century, of a country family in comfortable circumstances, he was apparently entered in a monastic school at the age of nine. There he remained some twenty years, acquiring a very thorough knowledge of Latin and Greek, in spite of the efforts of the Franciscan Friars to prevent it—efforts for which he cordially despised them. Later his transfer to the kindlier, more enlightened order of the Benedictines, relieved him of the necessity literally to fight for his learning. But in 1524, about the age of thirty, he doffed his monkish habit and set forth upon his restless way through life.

He probably studied law at Bourge and Orleans, during the next two or three years, for his books evidence a considerable knowledge of common law, as well as canon law. But he must have been disgusted with its injustices, its dishonesties and delays, for he seems to have gone to Paris in 1528 and remained for two years, probably engaged in medical studies. I say probably because no one really knows. But it is known that at Montpellier, where he matriculated for the M. B. degree in 1530, the requirements were three years of medical study based upon a thorough prerequisite of logic and philosophy. Yet, as we find that the Bachelier's degree was conferred upon him barely six weeks after his matriculation he must have completed his medical requirements elsewhere.

At Montpellier then he paid his matriculation fee of one golden crown and wrote in the Register, "I, François Rabelais, of Chinon, diocese of Tours, enter myself for the

purpose of studying medicine and choose for my Preceptor the illustrious master, Jean Schyron, doctor and regent in this University. I promise to observe all the rules of the said faculty of Medicine which are ordinarily kept by those who have in good faith given their name and solemn promise, according to custom; and, under this, I have signed with my own hand. This seventeenth of September in the Year of our Lord 1530."

Medicine was something of a fad among the Humanist group who considered it a branch of Philosophy, and doubtless Rabelais was better prepared than most students by his long previous training in the Humanities and his thorough knowledge of Greek and Latin. At any rate, the date, December 1, 1530, finds him paying another golden crown as fee and having the degree Bachelier en Médecine conferred upon him.

Part of the post hoc requirement for this degree was the "Petit Ordinaire", a three month's course of lectures to be given by the newly fledged Bachelier. Rabelais chose the "Aphorisms" of Hippocrates and the "Ars Parva" of Galen as his subject. Either because he desired to present a novelty, or perhaps to exhibit his unusual erudition, he lectured from the Greek texts instead of employing the usual Latin translations. This rather revolutionary plan succeeded, we are told, in securing excellent audiences, for novelty was as attractive then as now.

You can imagine the bitterness he felt against the early restraints of his monkish education, a bitterness which caused him to discard its outward symbol of the robe. You can equally imagine his delight in the freedom of a study where a critical attitude of mind had already begun to be encouraged. He expanded in this new freedom and entered with some zest into the enjoyments of his colleagues.

These, at Montpellier, consisted principally of banquets and theatricals. His account of one performance, in which Saporta, the Professor of Medicine and Chancellor of the University, and Tollet, another contemporary light of the profession, also took part, is clear and so direct as to sug-

gest that Rabelais may have written it himself or have adapted it from the Latin of Terence and the popular French of a Pathélin farce. At any rate he named it "The Moral Comedy of One who has married a Woman who is Dumb."

His course of lectures ran through the late Spring of 1531 and, having completed them, he vanished from Montpellier without any record of having made an effort to qualify as Licentiate or Doctor of Medicine. One has to surmise the reason why he thus broke off his course of studies. His was a restless soul and perhaps he could not contemplate with equanimity the necessary tedium without change of occupation. The requirements for Licentiate were four tests, sustaining four successive theses on subjects assigned the night before. Each disputation lasted one hour. Then, after eight days, two more theses; the first having to do with some specific disease, the second with the Aphorisms of Hippocrates. The disease or aphorism was selected by lot from a book held, in the one instance by the Chancellor; in the other by the Dean. These disputations likewise lasted four hours each. One can readily imagine a man who has just completed a three months course of lectures from a Greek text shrinking slightly from such a prescribed continuation. Perhaps he had previsioned the Antioch Plan and desired to put his knowledge to the test of practice; for it was one of his contentions that a physician should constantly check his book learning by his experience, a rather novel doctrine at that time. The more reasonable explanation is that he needed money for those golden crowns the fees demanded.

Whatever the reason, after a banquet, on October 9, 1531, he disappears from Montpellier and reappears in Lyons, the City of Printers, in 1532. Late in the Fall of that same year, he is appointed physician of l'Hotel Dieu, at an annual recompense of fifty livres. This salary was of importance because, still a lay brother of the church, he was not allowed to charge for his medical services. Thus in a way he was an early forerunner of the presently popular "Full Time Man." He appeared, too, divided in his mind

between two doctrines; the then all-powerful authority of the Ancients (one even swore by Hippocrates) and the study of Nature, to which his own insatiable curiosity much inclined him. Following the latter urge, he made "An Anatomy", as it was called; a dissection of the human body, at the Hotel Dieu, in spite of this practice being condemned by the Church, repudiated by custom and scarcely approved by learned men.

Although in Italy dissections had been freely made for about two hundred years, they were still rare in France, only four a year being allowed in Paris and one a year at Montpellier. It was before Vesalius had begun to hunt cadavers beneath the gibbets and in the cemeteries. Only one criminal per annum was allotted to the Anatomist of Lyons. So rare indeed was this privilege that records were kept of them in the University Archives.

This particular dissection by Rabelais was celebrated in excellent Latin verse by his printer-poet friend and admirer, Étienne Dolet. His verse makes the very corpse gloat over the honor of being dismembered by the illustrious Maitre François Rabelais, in these words: "Strangled by the fatal noose, I hung miserably impotent. Then unhoped for good luck arrived such as I would scarcely have dared beg the mighty Jupiter for. Behold me now, being dissected by the most learned of physicians, who is about to admire, in the machine of my body, the incomparable order, the sublime beauty of the human body, the greatest work of the Creator. The crowd looks on attentively—what signal honor and what excess of glory for me! And to think that I was to have been the plaything of winds, the prey of rapacious crows! Ah! Destiny can hardly harm me now. I bathe in glory!"

In spite of this excellent beginning Rabelais, dividing his time between the hospital and the Printery of Sebastian Gryph, began to give too much time to the latter. He absented himself from the hospital several times without leave and for that mistake was speedily replaced. His salary gone, he must then apply himself in earnest to his bookmaking.

The year 1532 must have been a painfully busy time for Maitre François. There, in Lyons, and in that one year, he brought out no less than four publications. On June 3rd, his translations of the "Epistolae Medicinales" of Manardi, appeared, dedicated to the learned Judge Tiragueau. A translation of the "Aphorisms" of Hippocrates came forth on July 15th, dedicated to the very liberal Bishop Geoffrey d'Estresac, to whom Rabelais was deeply indebted. And, on that same date, came a translation of the "Ars Parva" of Galen, dedicated to those Third and Fourth Estates of Medicine, the Surgeons of the Long Robe and the Barber Surgeons.

To them he wrote, "And as for Surgery (which is after all but manual work) the Doctors esteem it a thing too low and quite unworthy of their profession; and not alone the labor of it (which Hippocrates and Galen were not ashamed to practice) but even the method of curing ulcers and unnatural tumors are held by them to be derogatory to their dignity. It follows that the Barbers and the Surgeons are today more studious than any Doctors. And this is the reason I have translated from Latin into French the Fourth Book of the method of Galen, because of the great and eager desire that I have recognized among said Surgeons to understand such things."

These publications, in addition to proof-reading and editing the manuscripts of others, would provide a sufficiency for one man; but Rabelais was indefatigable, and besides, needed money. Greek translations, like learned books of today, brought much honor but little cash.

He had noted, perhaps earlier but certainly in the early part of 1532, the enormous success of an extraordinary, though perhaps rather dull tale of a fabulous personage entitled, "Les Grands et Inestimables Croniques des Grands et Enorme Geant Gargantua." It is quite possible he had read proof on this and edited it. Even so, he observed its success, for it sold at the spring fairs in Frankfort and Lyons, where books were principally marketed, "more copies than had been sold of Bibles in the preceding nine years."

Rabelais was a thoroughly practical-minded man. One can imagine him saying, "Here is a gold mine, not yet exhausted." So his Pantagruel was conceived, borrowing a skeleton from the other book but clothing it in a new flesh of vivid, tremendous reality. No one knows how long he may have been working upon it, but it too was published in 1532.

Now, for a term, he apparently turned from Medicine to Literature, perhaps because he loved letters better than the healing art. "Gargantua" followed Pantagruel, in 1533, and then perhaps he turned again to Medicine and its practice. We actually know little of him till 1537 when he returned again to Montpellier, this time for his Licentiate and Docteur en Médecine. Perhaps he was weary of being a cleric without a curacy, a lawyer without a brief, a physician without a title; or perhaps his mind, his busy, restless, enquiring mind had been fixed upon it all the time and he had lacked the money to buy his dream. At any rate he was back again in Montpellier, in 1537 and fulfilled the requirement for Licentiate. On the twenty-second of May he was ready for admission to the Doctorate. After a series of six strenuous examinations covering three days, he received a two-third's Faculty vote and was ready for the final "Actus Triumphalis," the crowning ceremony in the Church of St. Firmin.

Imagine it for yourselves. It was heralded by the tolling of a great bell. There was an Academic Procession, followed by Latin addresses and the presentation of diplomas. After this the newly created Doctor distributed gloves and sweetmeats to those present. It was as though he had finally, after a long courting, been officially wedded to wisdom. The Doctor's bonnet was of black cloth with a bright tassel of silks. The ceremonies concluded by the President seating the new Doctor by his side, while he extended greetings and a benediction. Through these trials and tribulations and by this form and symbol, M. François Rabelais became a fully recognized physician and was speedily appointed one of the four Professors in

Ordinary of the Faculty of Medicine of the University of Montpellier.

He was at this time about 43 years old and with enhanced reputation and the dignity of a title entered upon the practice of Medicine and upon medical pedagogy. He was successful in both branches. His lectures on Botany and Anatomy were well attended and his patients praised his skill and his personality. This we observe in a verse of Sussanneau to Rabelais, bewailing the fact that no drugs could do him any good. "But you can," he writes to Rabelais, "for, if I am not mistaken, your patient is languishing from no other disease than a desire to see you. As soon as he catches a glimpse of your cheerful countenance, that languor which, up to then, he has felt all over his body will vanish quite."

His formal lectures, his "Grand Ordinaire," which were a part of his requirements for the Doctor's degree, Rabelais began, on September 27, 1537 and again he lectured from a Greek text, the "Prognostics" of Hippocrates. They lasted for one Semester and were enthusiastically received. His exhortations extended outside the classroom, too, at this time, for we find him admonishing his learned but lazy friend, Sussanneau, in these words: "You might at least go in for publishing useful treatises and doing research in diseases and their treatment, to pay off your debt to the State and justify your degree of Doctor of Laws and of Medicine."

Rabelais' formal lectures, one suspects, may have been as dull as his informal writings were lively and ingenious. One famous example of his method of mixing scientific fact inextricably with legend and rolling the whole in humorous obscenity before his smiling audience, is that passage from Gargantua describing this genial giant's miraculous birth from the left ear of his mother, Gargamelle. It is in part a satire on that curious bit of theology of the early Church which, to keep the Virgin "immaculate", caused her to become pregnant through the words of an angel, "Verbum caro factum est." In

paintings on church windows the angel's message is represented as a ray of light penetrating the Virgin's left ear. Sometimes the tiny image of a child is shown in the ray. This legend is found also in the hymn of St. Ephrem:

"Gaude, virgo, mater Christi
Quae per aurem concepisti,
Gabriele nuntio"

But the miraculous birth of Gargantua was not only a satire on this curious legend, it was also the vehicle by which Rabelais could export his anatomical and obstetrical learning outside the narrow limits of the class room. Rabelais gives a very vivid description of the difficulties of labor omitting no humorous particulars and then, calling upon his imagination equally as upon his knowledge of anatomy, he boldly proceeds to the climax of this almost virgin birth.

"Unable to find release from the embraces of the womb, the infant turned a somersault, entered the vena cava inferior and, passing by the diaphragm, ascended to the level of the shoulders where this vein divides. There taking his way to the left, he emerged from his mother's left ear." Even in satire he is consistent in specifying the same portal for the entrance of the seed and the exit of the fruit.

Rabelais here not only ridicules the ignorance of the mid-wives in his day and laughs at the commonly current stories of miraculous birth but a little later on satirizes the superstitious beliefs which, at that time, attributed special significance to the first cry of the new born. "For," the author declares "the instant he was born he did not cry, like other infants, 'miaow, miaow,' but shouted in a loud voice 'a drink, a drink,' as if he were inviting the whole world to drink."

Much of Rabelais' medical practice, like that of other physicians of the day was among patients with venereal disease. It is natural then to find him alluding frequently to carnal concupiscence, the frailty of women and the best means of reducing the former and circumscribing the latter in his second and third books.

His language was that of the day. It was no more gross than words used at times by John Calvin or Martin Luther from the pulpit. Friar Jean Raulin's "Sermon on Widowhood" is said to be racy reading even today. The language of such reverend fathers as Oliver Maillard and Jean Bourgeoise, even in the presence of royalty, makes the speech of Panurge seem almost restrained. The speech of that Century indeed alluded to the obvious physiological functions of the body with the same natural human zest in them as was brought to the burning of a heretic. It was symbolic of an age of Spring bursting the iron restraints of an age of Winter, when the freedom of the Renaissance finally broke the dam with which the Middle Ages had tried to limit the flow of the river of life. It was therefore natural for commentators living in an age of greater restraint to represent Rabelais as a roysterer and libertine. Later researches into his life and times have changed the gaudy colors of that picture. No one now who knows how hard he worked, how truly devoted he was to learning and how much he was admired by the learned men of his own day, can fail to appreciate his greatness or to applaud the courage with which he satirized the abuses of the Church and the Courts.

It is perhaps a question whether Rabelais should be regarded primarily as a surgeon, an internist or a specialist in Public Health. At any rate he understood the fallacy of shutting off the chief branches from one another, for we find him writing in the preface to his translation of the XIII Book of Galen: "Such books as the III to VI and XIII and XIV, are very necessary for Surgeons. As for the other six books they treat of abnormal temperatures, embracing fevers, or of the maladies that the Greek calls symptoms, particularly in the XII Book. For this reason we have omitted the translation of the said six books, considering that the contents are more suitable to physicians than to surgeons. I say more suitable. But, in spite of the Art of Medicine having been divided into three parts, one part cannot be separated from the others without detriment to the whole medical profession as we have very plainly shown in the commentary in the XIV Book—for

the reason that the consideration and knowledge of fevers and the reverse are by no means unimportant to methodical surgeons."

In spite of the fact that he apparently invented an improvement on the glottocome of Hippocrates for traction in fractures and an improvement on the syringotome of Galen, which he adapted to cut the constricting band in strangulated hernia, Rabelais was not primarily a surgeon. Much of his fame as a practicing physician seems to have come from his treatment of venereal diseases, rife at that time throughout France.

Gonorrhea apparently interested him but little and he alludes to it only in one passage of his works, where he says, "it causes a burning piss which torments one more than he would think. But medicines relieve this very satisfactorily and, by means of drugs, mild purgatives and diuretics, we can cause the patient to piss without pain." He then goes on to reflect bitterly about "the crowd of fool philosophers and physicians who lose time disputing about whence comes the heat of this water."

It is interesting to observe that in relation to sexual disorders in women, Rabelais adopts the opinion of Plato who, in the Timaeus, refers to the uterus as a small, voracious animal, hungry for its prey, and believes that the starving of this little animal is fraught with dire results to its host—a concept that some psychiatrists seem not disinclined to follow in these times. At least Rabelais makes old Rondibilis adopt this idea, whether he himself really held it or not.

We cannot follow Rabelais on his visits to Italy where he served as personal physician to Cardinal du Bellay on his mission to the Papal Court, but doubtless he learned there a good deal about the treatment of Syphilis. So we are not surprised to find him, in 1547, a paid physician of the city of Metz whither he fled to avoid implication in the threat of heresy which had been laid against his friend, Étienne Dolet.

At the hospital of St. Nicholas, where he worked, the patients were divided on admission into "les bons malades" and "les pauvres malades," the latter term denoting patients who had plague, leprosy or syphilis. These were assigned to Rabelais and he had also the duty of inspecting medically the public prostitutes. These had since the time of Louis XI been housed in "maisons closes" which were given the name of "bordeux" (hence "Bawdy" houses?) and were limited to special streets.

Syphilis was wide spread, even in high society and Rabelais comments upon it through his character Epistemon, describing what he has seen in Hell. "The Pope Sixtus," relates Epistemon, "was a grease of Syphilis." "What?" cries Pantagruel, "do they have Syphilis there?" "Certainly," answers Epistemon, "I don't know how many, but more than a hundred million of them. For, believe you me, those who don't have Syphilis in this world have it in the next."

Rabelais adopted the method of Torella with mercurial rubbings of one to forty mercury ointment, which others had found successful. Soon after the year 1500, Benegario da Carpi had made a great fortune by rubbing away Syphilis with mercurial ointment. Thierry de Hery, a barber-surgeon who followed the Italian Army, wrote a book in 1537, enlarging Torella's descriptions. He was an enthusiast about the matter and frank withal about his reasons for it. To one who, seeing him kneel before the statue of Charles VIII, remonstrated that Charles was no saint, he replied, "Silence friend, I know well what I do. He is indeed a saint to me because he was the means of my earning 30,000 livres de rente because he brought Syphilis into France." And Rabelais doubtless knew and followed the work of Hery though not to the same gainful extent.

The growing enthusiasm for this form of treatment resulted in pitiful and grotesque excesses which Rabelais describes. "How often have we seen," he says, "at the time they are well-anointed and greased at every point, their faces swollen and their teeth rattling loosely like the keys of a clavier or a spinet."

There is, unfortunately, practically no detailed knowledge of Rabelais' practice, but there is enough perhaps to indicate that he was a real Doctor and, in spite of his lapses into literature, deeply and sincerely interested in his work and in his patients.

After the Sorbonne had banned his popular works, he complains piteously, "They have snatched them away from the sick, the gouty, the unfortunates for whom I had originally composed these books." And then he adds, somewhat grandiloquently, "For, if I could take under my personal care all who are sick and ailing, there would be no need for works such as mine." Later, he adds, "since then it is not possible for me to be called in by all the sick, or to take all patients under my care, how great a piece of spite work it is to want to deprive the ill and languishing ones of whatever amusement they may, without offense to God, the King, or any other, be able to find in listening to those merry books of mine, when those books are read to them in my absence."

Rabelais died a long time ago and he should not be judged only by what men of other centuries thought of him. Let us for a moment look at some of the contemporary expressions of men who knew him. Étienne Dolet wrote a poem celebrating a dinner given in his own honor on the occasion of his having received the King's pardon for a manslaughter which he had committed in self defense. He names all the prominent guests and, of Rabelais, he says, "François Rabelais, the honor and sure glory of the healing art, who even from the gates of Pluto can recall the dead and restore them to the light." Salmon Macrin, a well known poet of the time, in a Latin ode of the same period addressed to "Rabelais, the Most Skilful Physician," writes, "Paris, Narbonne, the banks of the Aude and Lyons, where you make your home, are witnesses of your skill." And Boulanger, a learned Physician of Loudun, said in a Latin poem, printed twenty years after Rabelais' death, but evidently intended as an epitaph, "you will perhaps think the man a buffoon and a jester, one who angled for

dinners with witty speeches. No! he was no buffoon, no jester of the market place, but one who, with the penetration of a distinguished mind, laughed at the human race, its foolish wishes, it credulous hopes . . . Nor would you find any more learned, when it pleased him to lay aside laughter for serious topics . . . If a great and difficult question had to be decided, you would have said that he and he alone saw into the greatest mysteries, that to him alone were revealed the secrets of Nature . . . He was familiar with all the learning of Greece and Rome and, like a second Democritus, laughed at the idle fears and hopes of the populace and princes and at the vain cares and anxious labors of this transitory life."

By the Sorbonne he was of course looked upon as a menace and a blasphemer; but is that in itself not a compliment? Later and more accurate researches have brought forward a new Rabelais and one that you cannot help feeling is much nearer to the real man himself. He was a man of brain, a man of spirit, a man of heart, rather than a creature furnished only with gullet, belly and genitals. One may no longer think of Rabelais, the man or the physician, as a fat, greasy rascal with a prurient smile upon his face and a dirty word upon his lips. On the contrary, he was a man of distinguished learning, a most courageous combattant against the evils of the government, the law and the church as well as against disease. But above all Rabelais was a most human man.

REFERENCES

1. "François Rabelais", illustrated reprint, by D. Charles Greene Cumston. A conference at the University of Geneva, 1918.
2. "Rabelais in his Writings", by W. F. Smith.
3. "François Rabelais", by Samuel Putnam, 1929, N. Y. City.
4. "Rabelais", by Anatole France, 1928, Paris.
5. "F. Rabelais", by J. Plattard.
6. "Rabelais, Chirurgien", by A. H. Nivernoys.

Abstracts of Papers Presented Before the Section of Obstetrics and Gynecology, April 27, 1937

1. OBSTETRICS AND GYNECOLOGY FROM THE PUBLIC HEALTH VIEWPOINT

JOHN L. RICE

Commissioner of Health

Attention was called to the large number of deaths charged to prematurity, and Chicago's plan for dealing with this situation was recommended to serve as an example for other cities. In connection with the large number of infant deaths now charged to injuries at birth,—Dr. Rice presented figures showing that last year 22.2 per cent of the births in this city were delivered by some form of operative procedure and obstetricians were asked to consider: (a) to what extent is operative interference justified; (b) was the type of operative interference the proper one; (c) was the operator qualified to undertake it. He made special reference to 2.3 per cent of cesarean deliveries and questioned whether this proportion was at all necessary. In speaking of deaths charged to asphyxia Dr. Rice wondered whether twilight sleep had not been a factor in a significant number of such deaths. The obstetricians had some responsibility also for deaths reported as stillbirths, especially those occurring after completing thirty-five weeks of pregnancy. These, together with the live-born infants who died within the first week, amounted to 3815 deaths which, said Dr. Rice, "presents a challenge" to the obstetricians. He reminded them also of 459 maternal deaths occurring in New York City during 1936.

The great havoc now caused by the venereal diseases was emphasized and cooperation with the Department of Health in its efforts to control these infections was asked. He also urged that obstetricians give due consideration to avoid the disabilities caused by injuries to mothers during childbirth.

"My assignment," concluded Dr. Rice, "was to point out the problems as they relate to the public health. Let us hear concrete suggestions for meeting them. I hope that this will not be 'just another meeting'. The situation demands more than mere discussion; it calls for action."

2. COURSE, CONDUCT, AND COMPLICATIONS OF LABOR AMONG PHYSICIANS' WIVES

R. D. MUSSEY

JOHN FABER

The group was selected as typifying the private practice of obstetrics among women from whom understanding cooperation could be expected during pregnancy and labor. This forms a natural method of sampling the obstetric practice from January 1, 1914 to January 1, 1937.

Data from the case records of these, 553 consecutive confinements among 241 physicians' wives, have been grouped under four general

headings. (1) Prepartum examination and care (2) Aseptic technic (3) The perfection of methods of operative delivery (4) Anesthesia and analgesia.

Adequate prepartum care is recorded in 472 pregnancies. There were eight patients with pre-eclampsia, one with nephrosis and one with postpartum eclampsia. A splenectomy for hemorrhagic purpura was performed during pregnancy without untoward incident.

Complicating labor there were two cases of placenta previa and three of premature partial placental separation. There were ten postpartum hemorrhages of mild, and two of severe degree. Twenty-one patients had puerperal morbidity; there was no proven septicemia.

Eighty-one of the 553 confinements were complicated by some degree of pelvic contraction. Occiput posterior positions were recorded sixty-seven times, breech twenty-five times and face once.

Mention is made of the persistently high national maternal mortality rate from puerperal sepsis, together with the need for constant attention to the details of asepsis. Induction of labor by mechanical means without clear obstetric indications is questioned.

Five hundred sixty-one infants were born to 553 women; 412 births, including 16 breech deliveries, were spontaneous, 126 were vaginal operative deliveries, and 23 including one set of twins were by abdominal cesarean section.

There were no maternal deaths. The total fetal death rate was 3.9 per cent. Subtracting the premature stillbirths and the full term prepartum stillbirths, this leaves a fetal mortality of 2.4 per cent.

Comment is made that the injudicious use of analgesia and anesthesia is responsible for a marked increase in the incidence of operative deliveries which in turn tends to increase fetal and maternal complications, particularly puerperal sepsis.

3. OBSTETRICS AND GYNECOLOGY FROM THE VIEWPOINT OF THE MEDICAL EXAMINER

HARRISON S. MARTLAND

The interest of the Medical Examiner in obstetrics and gynecology is concerned principally with deaths following abortion; while under anaesthesia; within 24 hours after admission to a hospital; after unnecessary operations; from pulmonary embolism; due to the use of drugs, especially those causing agranulocytosis; from transfusion accidents; and similar conditions. Also neonatal deaths due to prematurity; asphyxia; birth injuries; intracranial hemorrhage; burns; poisoning; deaths in incubators, cribs. The medicolegal aspects and prevention of many of these fatalities are discussed in detail.

The increase in criminal abortion and birth control is becoming a serious problem. The present birth rate in this country is barely capable of maintaining our population. Conviction of the professional abor-

tionist is extremely difficult. He comes to the notice of the police only if a woman dies or "squeals". Juries rarely convict, for many individuals have had abortions performed in their immediate families and condone the practice; judges often believe criminal abortion should be legalized; the time worn defense that the woman was bleeding when the abortionist saw her, has the prosecution "licked" from the start; abortionists have been known to contribute heavily to political campaigns, and "fiddle-faced" politicians often aid in obstructing justice.

In the discussion of "Reproductive Waste" due to criminal abortion, venereal disease, birth control and other deviations, three solutions are offered:

(1) "Let things ride"—ignore the existence of the situation.

(2) Attempt to strengthen the present social structure—formulate a policy of reproduction, with positive encouragement of motherhood, State awards for children, legalization of illegitimates; better economic conditions, to facilitate marriage of young people; enforce our present laws, compile police lists of known abortionists, enforce strict regulation of semimedical quacks—and encourage religious morality, the main barrier against a world "going haywire".

(3) Legalize criminal abortion, birth control, free love, nudist colonies, euthanasia, ad nauseam.

Regardless of political or social changes, the medical profession must remain independent and "clean". We must, however, consider the conservation of child-bearing women, the reduction of maternal and infant mortality, and an unrelenting drive against venereal disease as our responsibility.

MEMBERS ELECTED MAY 6, 1937

COMMITTEE ON ADMISSION

Arthur H. Aufses.....1085 Park Avenue
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Carl H. Smith.....119 East 84 Street
Benjamin Morgan Vance.....119 East 84 Street
Franklin Howard Westcott.....1435 Lexington Ave.

A SELECTION OF RECENT ACCESSIONS

"Possession does not imply approval"

American Foundation. American medicine; expert testimony out of court.
N. Y., American Foundation, [1937], 2.v.

Bainbridge, F. A. and Menzies, J. A. Essentials of physiology. 8.ed.
London, Longmans, [1936], 651 p.

Baldwin, E. An introduction to comparative biochemistry.
Cambridge [Eng.], Univ. Press, 1937, 112 p.

Bentley, J. E. Superior children: their physiological, psychological and social development.
N. Y., Norton, [1937], 331 p.

Bing, R. Lehrbuch der Nervenkrankheiten. 5.Aufl.
Berlin, Urban, 1937, 618 p.

Bircher, E. Das Kropfproblem.
Dresden, Steinkopff, 1937, 143 p.

Brandt, G. Verzögerte Knochenbruchheilung und Pseudarthrosenbildung.
Leipzig, Thieme, 1937, 175 p.

Braun, A. Medizinisches aus der Weltliteratur.
Stuttgart, Enke, 1937, 152 p.

Burns, B. H. and Ellis, V. H. Recent advances in orthopaedic surgery.
London, Churchill, 1937, 296 p.

Darlington, C. D. Recent advances in cytology. 2.ed.
London, Churchill, 1937, 671 p.

Davis, A. E. Cataract, its preventive and medical treatment.
Phil., Davis, 1937, 161 p.

Davis, H. T. and Nelson, W. F. C. Elements of statistics. 2.ed.
Bloomington, Ind., Principia Press, [1937], 434 p.

Elliott, G. L. Women after forty.
N. Y., Holt, [1936], 213 p.

Fischer, M. H. Christian R. Holmes, man and physician.
Springfield, Ill., Thomas, 1937, 233 p.

Hackett, C. J. Boomerang leg and yaws in Australian aborigines.
London, Royal Society of Tropical Medicine and Hygiene, 1936, 66 p.

Haggard, H. W. Staying young beyond your years.
N. Y., Funk, [1937], 89 p.

Handbook of microscopical technique. Edited by C. E. McClung. 2.ed.
N. Y., Hoeber, 1937, 698 p.

Harris, L. J. Vitamins in theory and practice. [2.ed.]
N. Y., Macmillan, [1937], 242 p.

Histoier générale de la médecine. . .publié sous la direction du Docteur Laignel-Lavastine.
Paris, Michel, [1936], v.1.

International surgical association. Dixième congrès de la Société internationale de chirurgie, Le Caire, 31 déc. 1935—4 jan. 1936. Rapports, procès-verbaux et discussions.
Bruxelles, Imprimerie Méd. Scien., 1936, 3 v.

Kleinschmidt, H. E. Tuberculosis. [Rev. ed.]
N. Y., Funk, [1937], 77 p.

Kötschau, K. and Meyer, A. Theoretische Grundlagen zum Aufbau einer biologischen Medizin.
Dresden, Steinkopff, 1936, 217 p.

Koll, I. S. Medical urology.
St. Louis, Mosby, 1937, 431 p.

Kopsch, F. W. T. Die Nomina anatomica des Jahres 1895 (B.N.A.).
Leipzig, Thieme, 1937, 103 p.

Loewenberg, S. A. Clinical endocrinology.
Phil., Davis, 1937, 825 p.

Maher, C. C. Electrocardiography. 2.ed.
Balt., Wood, 1937, 254 p.

Mauz, F. Die Veranlagung zu Krampfanfällen.
Leipzig, Thieme, 1937, 68 p.

Miner, L. M. S. Why the teeth?
N. Y., Funk, [1937], 71 p.

Orton, S. T. Reading, writing and speech problems in children.
N. Y., Norton, [1937], 215 p.

Plant, J. S. Personality and the cultural pattern.
N. Y., Commonwealth Fund, 1937, 432 p.

Reinig, W. F. Melanismus, Albinismus und Rufinismus.
Leipzig, Thieme, 1937, 122 p.

Rice, T. B. The human body.
N. Y., Funk, [1937], 88 p.

Risak, E. Der klinische Blick.
Wien, Springer, 1937, 153 p.

Rose, (Mrs.) M. D. (Swartz). The foundations of nutrition. Rev.ed.
N. Y., Macmillan, 1937, 630 p.

Rowell, H. G. Hear better.
N. Y., Funk, [1937], 83 p.

Schwarz, G.; Goldberger, J. and Crocker, C. Diagnosis and non-operative treatment of the diseases of the colon and rectum.
N. Y., Hoeber, 1937, 540 p.

Scott, G. R. A history of prostitution.
London, Laurie, [1936], 239 p.

Scott, J. R. Diabetes.
N. Y., Funk, [1937], 132 p.

Shands, A. R. and Raney, R. B. Handbook of orthopaedic surgery.
St. Louis, Mosby, 1937, 593 p.

Stumpf, P. Zehn Vorlesungen über Kymographie.
Leipzig, Thieme, 1937, 112 p.

Sutherland, H. G. In my path.
London, Bles, [1936], 263 p.

Vaughan, K. O. Safe childbirth.
London, Baillière, 1937, 154 p.

Warbasse, J. P. and Smyth, C. M. Surgical treatment. 2.ed.
Phil., Saunders, 1937, 3 v. and index.

Whitwell, J. R. Historical notes on psychiatry.
London, Lewis, 1936, 252 p.

Wilder, J. Klinik und Therapie der Zuckermangelkrankheit.
Wien, Weidmann, 1936, 100 p.

Wilke, G. Die Heilkunde in der europäischen Vorzeit.
Leipzig, Kabitzsch, 1936, 418 p.

PROCEEDINGS OF ACADEMY MEETINGS

MAY

STATED MEETINGS

Called for the purpose of presenting to the Academy membership important matters connected with the finances and policies. The usual invitation to guests was suspended for this executive meeting of the Academy.

I. EXECUTIVE SESSION—1. Reading of the Minutes; 2. Presentation of Diplomas.

II. ACADEMY POLICIES AND FINANCES—James Alexander Miller, President; Alfred E. Cohn, Chairman, Committee on Library; George Baehr, Chairman, Committee on Public Health Relations; Carl Eggers, Chairman, Committee on Medical Education; Orrin S. Wightman, Medical Information Bureau; William Barclay Parsons, Chairman, Committee on Fellows and Members Fund Raising Campaign; Discussion.

III. REPORT ON ELECTION OF MEMBERS.

May 20

THE HARVEY SOCIETY (IN AFFILIATION WITH THE NEW YORK ACADEMY OF MEDICINE)

THE EIGHTH HARVEY LECTURE, "Transmissions of Nervous Effects by Acetylcholine," Sir Henry Dale, Director, National Institute for Medical Research, London, England.

SECTION MEETINGS

SECTION OF DERMATOLOGY AND SYPHILOGY—May 4

I. READING OF THE MINUTES.

II. PRESENTATION OF CASES—a. Beth Israel Hospital; b. Good Samaritan Dispensary; c. Sea View Hospital; d. Miscellaneous cases.

III. DISCUSSION OF SELECTED CASES.

IV. EXECUTIVE SESSION—Election of Section Officers and member of Advisory Committee; For Chairman, Louis Chargin; For Secretary, Harry C. Saunders; For member of Advisory Committee, A. Benson Cannon.

COMBINED MEETING OF SECTION OF NEUROLOGY AND PSYCHIATRY AND THE NEW YORK NEUROLOGICAL SOCIETY—May 4

(PLEASE NOTE CHANGE IN DATE)

I. PAPERS OF THE EVENING—a. The psychological relation between the physician and the patient, H. Nunberg; Discussion: William H. Dunn, L. S. Kubie; b. The feeling of stupidity, C. P. Oberndorf; Discussion: James H. Wall; c. The social neuroses, Paul Schilder; Discussion: Sandor Lorand, Simon Rothenberg; d. The transference phenomenon in a case of phobia, Fritz Wittels; Discussion: J. H. W. Van Ophuijsen.

II. EXECUTIVE SESSION— SECTION OF NEUROLOGY AND PSYCHIATRY—Election of Section Officers and member of Advisory Committee; For Chairman, Irving Pardee; For Secretary, Morris Grossman; For member of Advisory Committee, Abraham A. Brill.

SECTION OF SURGERY—May 7

I. READING OF THE MINUTES.

II. PRESENTATION OF CASES—a. 1. Case of excision of external condyle of humerus in an old fracture; 2. Case of pseudo-pancreatic cyst, James Harry Heyl; b. Case of stenosing tenovaginitis of the extensor tendon of the thumb, Harold Brown Keyes.

III. PAPERS OF THE EVENING—a. Diagnosis of non-specific mesenteric adenitis, William Klein; b. Clinical significance of biliary, pancreatic and duodenal reflux, Ralph Colp.

IV. GENERAL DISCUSSION.

V. EXECUTIVE SESSION—a. Election of Section Officers and member of Advisory Committee; For Chairman, Roderick V. Grace; For Secretary, Frank L. Meleney; For member of Advisory Committee, William F. MacFee.

Members of the Section were now invited to submit titles of case presentations, or papers for the programs of 1937-38.

SECTION OF HISTORICAL AND CULTURAL MEDICINE—May 12

I. EXECUTIVE SESSION—a. Reading of the minutes; b. Election of Section Officers and member of the Advisory Committee; For Chairman, Reginald Burbank; For Secretary, Howard Reid Craig; For member of the Advisory Committee, Jerome P. Webster.

II. PAPERS OF THE EVENING—a. Jean Dominique Larrey: A great military surgeon. (Lantern slide demonstration and exhibit of mementos), Paul E. Bechet; b. Medical explorers of Arabia, Iago Galdston.

III. GENERAL DISCUSSION.

SECTION OF PEDIATRICS—May 13

CASE DEMONSTRATIONS FROM 7:30 TO 8:00.

I. EXECUTIVE SESSION—Election of Section Officers and member of Advisory Committee; For Chairman, Samuel Z. Levine; For Secretary, Philip M. Stimson; For member of Advisory Committee, Alexander T. Martin.

II. PRESENTATION OF SINGLE CASE REPORTS—a. Babies' Hospital, Carcinoma of the thyroid, Alfred G. Langmann; b. Bellevue Hospital, Case of familial metaphyseal dysplasia, Harry Bakwin, Arthur Krida; c. Beth El Hospital, Brooklyn, Otogenic streptococcic meningitis with recovery, Abraham M. Litvak (by invitation); d. Beth Israel Hospital, Subacute meningococcemia without meningitis, J. M. Lewis; e. Israel Zion Hospital, Brooklyn, Brain abscess following purulent ethmoiditis, Mark J. Wallfield (by invitation); f. Jewish Hospital, Brooklyn, Rupture of the lung in a newly born infant, Harry Strongin (by invitation); g. Lenox Hill Hospital, Xeroderma pigmentosum with mental deficiency, A. G. Silberstein (by invitation); h. Long Island College Hospital, Brooklyn, Projectile vomiting due to partial urethral obstruction, Lewis A. Koch (by invitation); i. Mount Sinai, Renal rickets with pluriglandular syndrome, Jean Pakter (by invitation); j. Polyclinic Hospital, Torsion of the testicle in the new born, Harry Zuckerman (by invitation); k. Post-Graduate Hospital, Sarcoma of the mediastinum in a boy ten years old, George M. Wheatley (by invitation); l. Roosevelt Hospital, Wilms' tumor of the kidney, John F. Landon; m. St. Vincent's Hospital, Diaphragmatic hernia with operative repair, Thomas Waldie, Clarence Howley; n. Willard Parker Hospital, A second attack of poliomyelitis, Alfred E. Fischer, Maxwell Stillerman (by invitation).

SECTION OF OPHTHALMOLOGY—May 17

Program arranged by EYE DEPARTMENT OF ST. LUKE'S
Lenox Hill and Post-Graduate Hospitals

INSTRUCTIONAL HOUR, 7:00 to 8:00 p.m.—Congenital Ocular Muscle Anomalies, Rudolph Aebli.

REGULAR PROGRAM

I. EXECUTIVE SESSION—a. Reading of the Minutes; b. Election of Section Officers and member of the Advisory Committee; For Chairman, James W. White; For Secretary, Rudolph Aebli; For Member of Advisory Committee, John H. Dunnington.

II. REPORT OF CASES—a. Chancre of the upper eyelid in a two month's old infant, Alfred Appelbaum (by invitation); b. Synchysis scintillans in anterior chamber, Girolamo Bonaccolto; c. Paget's disease of the skull, W. Guernsey Frey; d. Laurence-Moon Biedl Syndrome, H. Templeton Smith; Discussion: John M. McKinney (by invitation).

III. PAPERS OF THE EVENING—a. The relation of ametropia to ocular motor anomalies, James W. White; b. Operative injuries of the eye, Percy Fridenbert (by invitation).

SECTION OF MEDICINE—May 18

HOUSE OFFICER AND RESIDENT PROGRAM

I. EXECUTIVE SESSION—Election of Section Officers and member of Advisory Committee; For Chairman, Joseph Hajek; For Secretary, Thomas T. Mackie; For member of Advisory Committee, Paul Reznikoff.

II. PAPERS OF THE EVENING—a. Cyanosis due to methemoglobinemia complicating para-amino-benzene-sulfonamide therapy, Irving Posner, New York Post-Graduate, Medical School and Hospital (by invitation) (12 minutes); Discussion: Walter G. Lough (5 minutes); b. Hypoproteinemia of undetermined origin, Max Needleman, Beth Israel Hospital (by invitation) (12 minutes); Discussion: H. Vesell (5 minutes); c. Torula meningo-encephalitis, James Weinberg, City Hospital (by invitation) (12 minutes); Discussion: J. Homer Cudmore (5 minutes); d. Still's disease with amyloidosis, Howard B. Shookhoff, Montefiore Hospital (by invitation) (12 minutes); Discussion: Leopold Lichtwitz (5 minutes); e. Insulin sensitivity in diabetes mellitus, Gerald Flaum, Third Medical Division, (N.Y.U.) Bellevue Hospital (by invitation) (12 minutes); Discussion: Elaine P. Ralli (5 minutes); f. The association of pulmonary abscess and tuberculosis, David F. Loewen, Tuberculosis Service (Columbia), Bellevue Hospital (by invitation) (12 minutes); g. Boeck's sarcoid, William T. Medl, St. Luke's Hospital (by invitation) (12 mintues); Discussion: Lewis F. Frissell (5 minutes); h. Early feeding (Meulengracht diet) in bleeding peptic ulcer, Edward R. Schlesinger, Mt. Sinai Hospital (by invitation) (12 minutes); Discussion: B. S. Oppenheimer (5 minutes).

SECTION OF GENITO-URINARY SURGERY—May 19

I. NEW INSTRUMENT—A hemostatic catheter: modification of Foley catheter, Robert Severance.

II. CASE REPORT—Carbuncle of the kidney: report of two cases, Harold E. Stedman (by invitation).

III. PAPER OF THE EVENING—A study of 150 consecutive cases of ureteral calculi, James B. Hicks, Boston (by invitation); Discussion by: Allister M. McLellan, J. Sydney Ritter, Francis P. Twinem.

IV. EXECUTIVE SESSION—Election of Section Officers and member of Advisory Committee; For Chairman, Fedor L. Senger; For Secretary, John A. Taylor; For member of Advisory Committee, Joseph A. Hyams.

SECTION OF OTOLARYNGOLOGY—May 19

I. EXECUTIVE SESSION—a. Reading of the Minutes; b. Election of Section Officers and member of Advisory Committee; For Chairman, Clarence H. Smith; For Secretary, James W. Babcock; For member of Advisory Committee, Edmund Prince Fowler.

II. PRESENTATION OF CASES AND INSTRUMENTS—a. Radiographic device for the antero-posterior mensuration of the ethmoids and sphenoids, Solomon Fineman; b. Carcinomatous metaphasia in case of uncontrollable polyposis of the nose, Irving B. Goldman; c. Frontal lobe abscess secondary to empyema of the sphenoid, Abraham Kaplan (by invitation).

III. PAPERS OF THE EVENING—1. Orbital infections due to nasal sinusitis. A study of 114 cases, Louis Hubert; Discussion by: Frank C. Keil, Francis W. White; 2. Osteomyelitis of the cranial vault. Lantern slides, Joseph E. King; Discussion by: E. Ross Faulkner, Frederick M. Law; 3. Infection of the carotid canal area cured by cervical operation, Mervin C. Myerson; 4. Air spaces in the skull in hemiatrophy of the brain, Leo M. Davidoff; 5. Some cases of special interest to the otolaryngologist seen on the neurological service, Page Northington.

IV. GENERAL DISCUSSION.

SECTION OF ORTHOPEDIC SURGERY—May 21

I. EXECUTIVE SESSION—a. Reading of the minutes; b. Election of Section Officers and member of Advisory Committee; For Chairman, Earl E. VanDerwerker; For Secretary, Joseph B. L'Episcopo; For member of the Advisory Committee, Nicholas S. Ransohoff.

II. PAPERS OF THE EVENING—a. Punch biopsy diagnosis of bone tumor, William J. Hoffman; b. Studies on the intervertebral disk, William L. Donahue (by invitation); c. Correction of dorsum rotundum, David R. Telson (by invitation); d. The evolution of the knee joint, Maurice H. Herzmark (by invitation); e. Abnormal gaits as a guide in diagnosis (motion picture demonstration), Samuel Boorstein; f. A new type of foot brace for the management of foot imbalances, Harry Weiner.

SECTION OF OBSTETRICS AND GYNECOLOGY—May 25

Residents' Program

PRESENTATIONS—10 minutes; DISCUSSIONS—5 minutes.

I. EXECUTIVE SESSION—a. Election of Section Officers and member of the Advisory Committee; For Chairman, Thomas E. Lavell; For Secretary, Edward H. Dennen; For member of the Advisory Committee, Arthur M. Reich.

II. PRESENTATION OF CASES—a. Morrisania City Hospital, Transverse septum of the vagina complicating pregnancy, two cases, Arthur M. Davids (by invitation); Discussion: Harry Aranow; b. Post-Graduate Hospital, Frank-Geist operation for congenital absence of vagina, Edward N. Smith (by invitation); Discussion: Walter T. Dannreuther.

III. PAPERS OF THE EVENING—a. Bellevue Hospital, Skin hyperasthenia in acute salpingitis, John S. Labate (by invitation); Discussion: Edward M. Livingston; b. Margaret Hague Maternity Hospital, Observations on the relative efficiency of two types of ergot preparations in the control of postpartum bleeding, Roger C. ter Kuile (by invitation); Discussion: S. A. Cosgrove; c. Methodist Episcopal Hospital, An x-ray study of gastric function during labor, Albert Hersheimer (by invitation); Discussion: George Hamilton Davis (by invitation); d. New York Hospital, Woman's Clinic, A study of elderly primipara, Cloyce R. Tew (by invitation); Discussion: Hervey C. Williamson; e. Sloane Hospital for Women, The significance of Clostridium Welchii in the genital tract of pregnant and puerperal women, Stanley M. Bysshe (by invitation); Discussion: Benjamin P. Watson; f. Woman's Hospital, Acid Allurate—A clinical study of this drug as a rectal analgesic during labor, Mary DeWitt Pettit (by invitation); William Alexander Graham (by invitation); Discussion: Ralph A. Hurd.

NEW YORK ROENTGEN SOCIETY *in affiliation with*
THE NEW YORK ACADEMY OF MEDICINE—May 17

I. PRESENTATION OF CASES.

II. PAPER OF THE EVENING—"Roentgen Ray Therapy as a Diagnostic Measure in Tumors of the Mediastinum and Superior Sulcus", John R. Carty.

III. GENERAL DISCUSSION—To be opened by: William deW. Andrus (by invitation); Maurice Lenz.

IV. EXECUTIVE SESSION.

NEW YORK MEETING OF THE SOCIETY FOR EXPERIMENTAL BIOLOGY AND MEDICINE—May 19

I. Selective axonal and trans-synaptic progression of certain viruses, and the role of localized barriers in preventing or arresting infection of the central nervous system, A. B. Sabin, Rockefeller Institute for Medical Research.

II. Studies on experimental hypertension, F. Glenn and C. G. Child III (Introduced by B. Webster) Cornell Medical College.

III. A case of diabetes mellitus refractory to insulin therapy, H. H. Mason (Introduced by A. E. Severinghaus) College of Physicians and Surgeons.

IV. Newer aspects of capillary structure and physiology. (Accompanied by motion pictures), B. W. Zweifach (Introduced by H. W. Smith) New York University.

The program of this meeting of the Society, which was open to members and their guests, consisted of invited papers.

NOTICE—Members were requested to attend this meeting to hear the report of the Nominating Committee and to act upon their nominations.

NEW YORK PATHOLOGICAL SOCIETY *in affiliation with* THE NEW YORK ACADEMY OF MEDICINE—May 27

I. CASE PRESENTATIONS—a. Complete absence of septum pellucidum, Vera B. Dolgopol; b. Spontaneous extrusion of spleen in a case of B. Welchii bacteremia, with recovery, S. H. Polayes.

II. PAPERS OF THE EVENING—a. Endocardial, arterial and other mesenchymal alterations in man associated with serum disease, Eugene Clark, Bernard Kaplan (by invitation); b. Tuberculous meningitis in relation to tuberculoma, David Beres (by invitation), Theodore Meltzer (by invitation).

III. EXECUTIVE SESSION.

DEATHS OF FELLOWS

Fox, George Henry, A.B., M.D., 145 East 54 Street, New York City; received the degree of Bachelor of Arts from Rochester University in 1867 and graduated in medicine from the University of Pennsylvania in 1869; elected a Fellow of the Academy January 8, 1880; died May 3, 1937. Dr. Fox had been surgeon to the New York Dispensary from 1873 to 1875; clinical professor of diseases of the skin at Woman's Medical College of New York Infirmary from 1875 to 1879; clinical professor of dermatology at Starling Medical College (Columbus, Ohio) in 1879; clinical professor of diseases of the skin from 1881 to 1904 and professor of dermatology from 1904 to 1907 at the College of Physicians and Surgeons (Columbia); and professor of skin diseases at the Post-Graduate Medical School from 1890 to 1895.

He was President of the New York County Medical Society in 1892, President of the State Medical Society in 1895 and Honorary President of the American Dermatological Association in 1926. He was a member of the Royal Society of Medicine (Great Britain), a Fellow of the American Medical Association and held a certificate from the American Board of Dermatology and Syphilology. Dr. Fox was the author and illustrator of many articles on dermatological subjects.

Pierson, Samuel, M.D., Stamford, Connecticut; graduated in medicine from the College of Physicians and Surgeons in 1881; elected a Fellow of the Academy April 2, 1896; died April 22, 1937.
Dr. Pierson was a Fellow of the American College of Surgeons and the American Medical Association and a member of the County and State Medical Societies.

Wyckoff, John Henry, M.D., 104 East 40 Street, New York City; graduated in medicine from the University and Bellevue Hospital Medical College in 1907; elected a Fellow of the Academy January 3, 1918; died June 1, 1937. Dr. Wyckoff had been Professor of Medicine and Dean of the New York University and Bellevue Hospital Medical College since 1932 and Director of the Third Medical Division at Bellevue Hospital since 1928. He was consulting physician to the Nyack, St. John's (Long Island City), Good Samaritan (Suffern), South Side (Bay Shore), Presbyterian (Newark), St. Luke's (Newburgh), St. Joseph's (Yonkers), and Mt. Vernon and St. Agnes (White Plains) Hospitals.

He was a Fellow of the American Medical Association, and a member of the Association of American Physicians, the American College of Physicians, the American Clinical and Climatological Association and the County and State Medical Societies. Dr. Wyckoff served the Academy as a member of the Committee on Medical Education since 1928 and as a member of the Committee on Public Health Relations in 1932. He was elected a member of the Board of Trustees in January, 1937.